



**BRITISH COLUMBIA
MINISTRY OF FORESTS**

Arrow Timber Supply Area

**Rationale for
Allowable Annual Cut (AAC)
Determination**

Effective April 30, 2001

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Chief Forester**



AAC Rationale for Arrow TSA

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Objective of this document

This document is intended to provide an accounting of the factors I have considered and the rationale I have employed as chief forester of British Columbia in making my determination, under Section 8 of the *Forest Act*, of the allowable annual cut (AAC) for the Arrow Timber Supply Area (TSA). This document also identifies where new or better information is needed for incorporation in future determinations.

Description of the TSA

The Arrow TSA comprises approximately 741 000 hectares in the West Kootenays, where it extends north from the British Columbia-United States border. The TSA is adjacent to several other management units, including the Boundary, Okanagan, Revelstoke and Kootenay Lake TSAs, and Tree Farm Licences (TFLs) 3 and 23. There are several parks within or adjacent to the TSA, including Kokanee Glacier and Valhalla Parks. Four new protected areas within or adjacent to the TSA which were created as a result of the implementation of the 1995 *Kootenay Boundary Land Use Plan* (KBLUP) are Syringa Creek, Goat Range, Gladstone and Granby. The Arrow TSA lies within the British Columbia Forest Service (BCFS) Nelson Forest Region and is administered from the Arrow Forest District office in Castlegar.

Approximately 40 percent of the TSA's population of 45,755 people live in the three major communities of Trail, Castlegar and Rossland. Other communities include Fruitvale, Warfield, Montrose, Nakusp, New Denver, Silverton, Slocan and Salmo. No First Nations communities are located in the TSA, although the Ktunaxa-Kinbasket, Shuswap and Okanagan Nations have asserted traditional territories within the TSA.

The Arrow TSA is ecologically complex, and its lower elevation forests have one of the greatest diversity of tree species in the province, including Douglas-fir, western larch, lodgepole pine, spruce, subalpine fir (balsam), western redcedar and western hemlock. The TSA contains abundant water resources, and approximately 47 percent of the timber harvesting land base lies in consumptive-use watersheds.

The five major licensees with operations in the Arrow TSA are Atco Lumber Limited (Ltd.), Bell Pole Co. Ltd., Kalesnikoff Lumber Co. Ltd., Riverside Forest Products Ltd., and Slocan Forest Products Ltd. These licensees form the consortium of the Arrow Forest Licence Group, which holds an Innovative Forest Practices Agreement (IFPA) in the TSA. The major licensees in the TSA also are members of the Arrow Forestry Association (AFA).

History of the AAC

The AAC for the Arrow TSA was determined in 1981 at 640 000 cubic metres. It was reduced in 1983 to 619 000 cubic metres per year following the creation of Valhalla Provincial Park. In the 1995 determination, the AAC was maintained at 619 000 cubic metres.

The AAC is currently apportioned by the Minister of Forests as follows:

Apportionment	cubic metres/year	Percentage
Forest Licences – replaceable (5)	490 002	79.1
Timber Sale Licence, less than or equal to 10 000 m ³ , replaceable	3 538	0.6
SBFEP category 1	48 208	7.8
SBFEP category 2	35 027	5.7
SBFEP bid proposal	26 319	4.2
Forest Service Reserve	6 206	1.0
Woodlot licences	9 700	1.6
Total	619 000	100.0

New AAC determination

Effective April 30, 2001 the new AAC for the Arrow TSA will be 550 000 cubic metres, a reduction of 11 percent from the current AAC.

This volume excludes 12 015 cubic metres per year of volume allocated to woodlot licences since the 1995 determination. This AAC will remain in effect until a new AAC is determined, which must take place within five years of this determination.

Information sources used in the AAC determination

Information considered in determining the AAC for the Arrow TSA include the following:

- *Arrow TSA Data Package and Information Report*, BCFS, January 1999;
- *Arrow TSA Analysis Report and Public Discussion Paper*, BCFS, April 2000;
- Arrow TSA draft Summary of Public Input on Data Package and TSA Analysis Report, BCFS, August 2000;
- Letter from the Minister of Forests to the chief forester, dated July 28, 1994, stating the Crown's economic and social objectives for the province;
- Memorandum from the Minister of Forests to the chief forester, dated February 26, 1996, stating the Crown's economic and social objectives for the province regarding visual resources;
- Technical review and evaluation of current operating conditions through comprehensive discussions with staff of the BCFS and Ministry of Environment, Lands and Parks (MELP), including the AAC determination meeting held in Castlegar, July 12 and 13, 2000;
- *Arrow TSA Rationale for AAC determination*, BCFS, September 6, 1995;
- *Arrow TSA Timber Supply Analysis*, BCFS, September 1994;
- *Arrow TSA Socio-Economic Analysis*, Resource Systems Management International, September 1994;
- *Forest Practices Code of British Columbia Act*, consolidated to June 1999;

- *Forest Practices Code of British Columbia Act Regulations and Amendments*, consolidated to June 1999;
- *Forest Practices Code of British Columbia Guidebooks*, BCFS and MELP;
- *Kootenay-Boundary Land Use Plan (KBLUP)*, 1995;
- *Kootenay Boundary Land Use Plan Implementation Strategy (KBLUP IS)*, 1997;
- *Kootenay-Boundary Higher Level Plan Order*, Final, BCFS, December, 2000;
- *Estimating Operational Adjustment Factor 2's Attributable to Armillaria Root Disease in Managed Forests in the Kootenay Lake TSA*, D. Norris, BCFS, March 2000;
- *Technical Report: Arrow TSA Timber Supply Option Analyses*, Timberline Forest Inventory Consultants and G. Rowe, June 8, 2000;
- *Arrow TSA Inventory Audit*, BCFS Inventory Branch, April 1997;
- *Age to Green-up: Using Regeneration Survey Data*, BCFS, October 2000;
- *Building a Healthy Valley Economy: A Community Action Plan*, Draft Final Report, November 1998;
- *Visual Landscape Inventory*, Mirkwood Ecological Consultants, 1994;
- *Forest Practices Code Timber Supply Analysis*, 1996;
- *Identified Wildlife Management Strategy*, February 1999;
- *Landscape Unit Planning Guide*, BCFS and MELP, March 1999;
- *Higher Level Plans: Policy and Procedures*, BCFS and MELP, December 1996.

Role and limitations of the technical information used

Section 8 of the *Forest Act* requires the chief forester to consider biophysical as well as social and economic information in AAC determinations. A timber supply analysis, and the inventory and growth and yield data used as inputs to the analysis, typically form the major body of technical information used in AAC determinations. Timber supply analyses and associated inventory information are concerned primarily with biophysical factors—such as the rate of timber growth and definition of the land base considered available for timber harvesting—and with management practices.

However, the analytical techniques used to assess timber supply are necessarily simplifications of the real world. There is uncertainty about many of the factors used as inputs to timber supply analysis due in part to variations in physical, biological and social conditions, although ongoing science-based improvements in the understanding of ecological dynamics will help reduce some of this uncertainty.

Furthermore, technical analytical methods such as computer models cannot incorporate all of the social, cultural and economic factors that are relevant when making forest management decisions. Therefore, technical information and analysis do not necessarily provide complete answers or solutions to forest management problems such as AAC determinations. The information does, however, provide valuable insight into potential impacts of different resource-use assumptions and actions, and thus forms an important component of the information required to be considered in AAC determinations.

In determining the AAC for the Arrow TSA, I have considered known limitations of the technical information provided, and I am satisfied that the information provides a suitable basis for my determination.

Statutory framework

Section 8 of the *Forest Act* requires the chief forester to consider particular factors in determining AACs for TSAs and TFLs. Section 8 is reproduced in full as Appendix 1.

Guiding principles for AAC determinations

Rapid changes in social values and in our understanding and management of complex forest ecosystems mean that there is always some uncertainty in the information used in AAC determinations. In making a large number of determinations for many forest management units over extended periods of time, administrative fairness requires consistency when addressing these changes and associated uncertainties. To make my approach in these matters explicit, I have set out the following body of guiding principles. If in some specific circumstance it is necessary to deviate from these principles, I will provide a detailed reasoning in the considerations that follow.

Two important ways of dealing with uncertainty are:

- (i) minimizing risk, in respect of which in making AAC determinations, I consider the uncertainty associated with the information before me, and attempt to assess the various potential current and future social, economic and environmental risks associated with a range of possible AACs; and
- (ii) redetermining AACs frequently, to ensure they incorporate current information and knowledge—a principle that has been recognized in the legislated requirement to redetermine AACs every five years. The adoption of this principle is central to many of the guiding principles that follow.

In considering the various factors that Section 8 of the *Forest Act* requires me to take into account in determining AACs, I attempt to reflect as closely as possible operability and forest management factors that are a reasonable extrapolation from current practices. It is not appropriate to base my decision on unsupported speculation with respect either to factors that could work to increase the timber supply—such as optimistic assumptions about harvesting in unconventional areas, or using unconventional technology, that are not substantiated by demonstrated performance—or to factors that could work to reduce the timber supply, such as integrated resource management objectives beyond those articulated in current planning guidelines or the *Forest Practices Code of British Columbia Act* and its associated regulations (the *Forest Practices Code*).

The *Forest Practices Code of British Columbia Regulations* were originally approved by the Lieutenant Governor in Council on April 12, 1995, and released to the public at that time. The *Forest Practices Code of British Columbia Act* was brought into force on June 15, 1995.

Although the *Forest Practices Code* has been fully implemented since the end of the transition period on June 15, 1997, the timber supply implications of some of its provisions, such as those for landscape-level biodiversity, still remain uncertain, particularly when considered in combination with other factors. In each AAC determination I take this uncertainty into account to the extent possible in context of the best available information.

The eventual timber supply impacts associated with strategic land-use decisions resulting from the various planning processes—including the Commission on Resources and Environment (CORE) process for regional plans, the Protected Areas Strategy, and Land and Resource Management Planning (LRMP) process—are often discussed in relation to current AAC

determinations. Since the outcomes of these planning processes are subject to significant uncertainty before formal approval by government, it has been and continues to be my position that in determining AACs it would be inappropriate to attempt to speculate on the timber supply impacts that will eventually result from land-use decisions not yet taken by government. Thus I do not account for possible impacts of existing or anticipated recommendations made by such planning processes, nor do I attempt to anticipate any action the government could take in response to such recommendations.

Moreover, even where government has made a formal land-use decision, it may not always be possible to fully analyze and account for the consequent timber supply impacts in a current AAC determination. In many cases, government's land-use decision must be followed by a number of detailed implementation decisions. For example, a land-use decision may require the establishment of resource management zones and resource management objectives and strategies for these zones. Until such implementation decisions are made it would be impossible to fully assess the overall impacts of the land-use decision. Nevertheless, the legislated requirement for five-year AAC reviews will ensure that future determinations address ongoing plan implementation decisions.

However, where specific protected areas have been designated by legislation or by order in council, these areas are deducted from the timber harvesting land base and are no longer considered to contribute to the timber supply in AAC determinations.

In the Arrow TSA, government's approval of the Kootenay-Boundary Land Use Plan (KBLUP) in 1995, and decisions on protected areas have clarified many aspects of land and resource use and management. The Kootenay-Boundary Higher Level Plan Order was designated by Cabinet on December 22, 2000. The implementation of this Higher Level Plan will provide further certainty regarding resource management in the area (see Kootenay-Boundary Land Use Plan section).

Forest Renewal British Columbia (FRBC) funds a number of intensive silviculture activities that have the potential to affect timber supply, particularly in the long-term. As with all components of my determinations, I require sound evidence before accounting for the effects of intensive silviculture on possible harvest levels. Nonetheless, I will consider information on the types and extent of planned and implemented practices as well as relevant scientific, empirical and analytical evidence on the likely magnitude and timing of any timber supply effects of intensive silviculture.

Some have suggested that, given the large uncertainties present with respect to much of the data in AAC determinations, any adjustments in AAC should wait until better data are available. I agree that some data are not complete, but this will always be true where information is constantly evolving and management issues are changing. Moreover, in the past, waiting for improved data created the extensive delays that resulted in the urgency to redetermine many outdated AACs between 1992 and 1996. In any case, the data and models available today are improved from those available in the past, and will undoubtedly provide for more reliable determinations.

Others have suggested that, in view of data uncertainties, I should immediately reduce some AACs in the interest of caution. However, any AAC determination I make must be the result of applying my judgement to the available information, taking any uncertainties into account. Given the large impacts that AAC determinations can have on communities, no responsible AAC determination can be made solely on the basis of a response to uncertainty. Nevertheless,

in making my determination, I may need to make allowances for risks that arise because of uncertainty.

With respect to First Nations' issues, I am aware of the Crown's legal obligations resulting from recent court decisions including those in the Supreme Court of Canada. The AAC that I determine should not in any way be construed as limiting those obligations under these decisions, and in this respect it should be noted that my determination does not prescribe a particular plan of harvesting activity within the Arrow TSA. It is also independent of any decision by the Minister of Forests with respect to subsequent allocation of the wood supply.

With respect to future treaty decisions, as with other land-use decisions it would be inappropriate for me to attempt to speculate on the impacts on timber supply that will result from decisions that have not yet been taken by government.

Overall, in making AAC determinations, I am mindful of my obligation as steward of the forest land of British Columbia, of the mandate of the Ministry of Forests as set out in Section 4 of the *Ministry of Forests Act*, and of my responsibilities under the *Forest Practices Code of British Columbia Act*.

The role of the base case

In considering the factors required under Section 8 of the *Forest Act* to be addressed in AAC determinations, I am assisted by timber supply forecasts provided to me through the work of the Timber Supply Review program for TSAs and TFLs.

For each AAC determination for a TSA, a timber supply analysis is carried out using an information package including data and information from three categories—land base inventory, timber growth and yield, and management practices. Using this set of data and a computer model (Forest Stand Simulator, or FSSIM), a series of timber supply forecasts is produced, reflecting different decline rates, starting harvest levels, and potential trade-offs between short- and long-term harvest levels.

From this range of forecasts, one is chosen which attempts to avoid excessive changes from decade to decade and significant timber shortages in the future, while ensuring the long-term productivity of forest lands. This is known as the 'base case' forecast, and forms the basis for comparison when assessing the effects of uncertainty on timber supply.

Because it represents only one in a number of theoretical forecasts, and because it incorporates information about which there may be some uncertainty, the base case forecast for a TSA is not an AAC recommendation. Rather, it is one possible forecast of timber supply, whose validity—as with all the other forecasts provided—depends on the validity of the data and assumptions incorporated into the computer simulation used to generate it.

Therefore, much of what follows in the considerations outlined below is an examination of the degree to which all the assumptions made in generating the base case forecast are realistic and current, and the degree to which its predictions of timber supply must be adjusted, if necessary, to more properly reflect the current situation.

These adjustments are made on the basis of informed judgement, using current available information about forest management, which may well have changed since the original information package was assembled. Forest management data is particularly subject to change during periods of legislative or regulatory change, such as the enactment of the Code, or during the implementation of new policies, procedures, guidelines or plans.

Thus it is important to remember, in reviewing the considerations which lead to the AAC determination, that while the timber supply analysis with which I am provided is integral to those considerations, the AAC determination itself is not a calculation but a synthesis of judgement and analysis in which numerous risks and uncertainties are weighed. Depending upon the outcome of these considerations, the AAC determined may or may not coincide with the base case forecast. Judgements that may be based in part on uncertain information are essentially qualitative in nature and, as such, are subject to an element of risk. Consequently, once an AAC has been determined, no additional precision or validation may be gained by attempting a computer analysis of the combined considerations to confirm the exact AAC determined.

Base case for the Arrow TSA

The base case harvest forecast presented in the April 2000 timber supply analysis report for the Arrow TSA incorporated the best available information on current forest management, land base and timber yields for the TSA. It included specific assumptions related to the following: implementation of the Forest Practices Code, formal establishment of landscape units and biodiversity emphasis options, designation of scenic corridors, and management direction arising from the KBLUP. These assumptions are discussed in detail in the considerations presented later in this rationale.

An accounting was applied in the analysis for 9700 cubic metres per year issued to woodlot licences since the previous determination. This resulted in an initial harvest level of 609 300 cubic metres per year.

With the factors described above and others appropriate to the TSA incorporated, a 'base case' was generated and submitted for public review. The base case harvest forecast indicated that the initial harvest level of 609 300 cubic metres per year could be maintained for one decade, followed by harvest level reductions in steps over the next two decades to 493 500 cubic metres per year by decade three. In decade nine, the mid-term harvest level increased again to 544 000 cubic metres per year, and finally in decade sixteen to the long-term harvest level of 557 000 cubic metres per year.

Several harvest forecasts would have been possible for the Arrow TSA, given the current management regime and assumptions made in the analysis. Some of the alternative forecasts are discussed later in this rationale under Alternative rates of harvest. Specific considerations which led to the choice of the base case harvest forecast included establishing an initial harvest level at the current AAC, and providing for an orderly transition from harvesting existing natural stands to future managed stands. In addition, a slightly greater volume of wood is available over the analysis horizon in the chosen base case harvest forecast than in the other alternatives. I have considered the reasoning used to select the base case and am satisfied that it provides a suitable basis from which to evaluate the assumptions regarding land base, management practices and timber yields.

In response to the release of the BCFS timber supply analysis report, the TSA major licensee contingent of the Arrow Forestry Association (AFA) submitted a technical report (for the purposes of simplicity, this report will be referred to as the AFA technical submission throughout this document). This technical submission presented several optional timber supply forecasts. In their analysis, the AFA modified several BCFS base case assumptions to represent what they believed to be a more appropriate reflection of current practice. In particular, the AFA requested consideration of a harvest forecast 'C', in which revised

assumptions for operability, terrain stability, genetic gain, visually sensitive areas and future road reductions were applied.

I have reviewed the information in the AFA technical report and discussed the report with BCFS staff. As discussed in the relevant sections of this rationale, I do not believe that the combined set of revised assumptions are necessarily more appropriate nor a better reflection of current practice than the assumptions applied in the BCFS base case analysis. However, where I have considered a revised assumption to have merit, I have taken it into account as discussed under the applicable factor.

I am satisfied that the BCFS base case harvest forecast provides a suitable reference point from which to assess available timber supply in the TSA. However, I have also considered all public input received on the data package and analysis report, and where appropriate I have discussed my considerations under the various factors presented in this rationale.

Consideration of Factors as Required by Section 8 of the *Forest Act*

Section 8 (8)

In determining an allowable annual cut under subsection (1) the chief forester, despite anything to the contrary in an agreement listed in section 12, must consider

- (a) the rate of timber production that may be sustained on the area, taking into account
 - (i) the composition of the forest and its expected rate of growth on the area,

Land base contributing to timber harvesting

- general comments

The total area of the Arrow TSA as estimated from the 1997 inventory file data is 740 777 hectares. A total of 131 855 hectares of the TSA are not managed directly by the BCFS, including parks, ecological reserves, private land and various special use permit areas. An additional 205 932 hectares or approximately 28 percent are considered unproductive, including rock, swamp, alpine areas and water bodies. Productive forest land managed by the BCFS is 402 990 hectares or approximately 54 percent of the total area.

As part of the process used to define the timber harvesting land base, a series of deductions are made from the productive forest land base. These deductions account for the factors that effectively reduce the suitability or availability of the productive forest area for harvest, for economic, ecological or social (e.g. parks) reasons. In the Arrow TSA, the deductions result in a timber harvesting land base of 202 201 hectares, or approximately 50 percent of the Crown productive forest land. The timber harvesting land base now estimated for the TSA is approximately 13 700 hectares smaller than that assumed in the last timber supply analysis.

My consideration of the deductions applied in the derivation of the timber harvesting land base is presented in the following sections of this rationale.

- economic and physical operability

Those portions of the TSA which are neither physically operable nor economically feasible to harvest are categorized as inoperable, and are excluded when deriving the timber harvesting land base. The most recent operability mapping for the Arrow TSA was completed in 1991. In the analysis, a total of 120 390 hectares or approximately 30 percent of the Crown productive forest was excluded from the timber harvesting land base as inoperable.

In 1998, a Total Chance Blocking (TCB) project was conducted for the Arrow TSA by BCFS Nelson Forest Region staff. Eight of the 21 landscape units in the TSA were examined to assess operability, and the results indicated more operable area than described by the 1991 mapping. Based on the results of the regional project, 3464 hectares were included in the timber harvesting land base in the analysis that had been previously excluded based on the 1991 mapping. However, upon closer examination district staff now believe that the areas described by the TCB project are not in fact operable, and should not have been included in the analysis.

Also in 1998, the AFA reviewed the conventional operable land base for the TSA described by the 1991 mapping. The review resulted in the recommendation in the AFA technical submission that 3800 hectares be added to the timber harvesting land base. This revised operability information was reviewed and accepted by BCFS district staff, but was not available in time to be incorporated into the timber supply analysis.

District staff have additional concerns about areas included in the timber harvesting land base that are operationally isolated and economically inaccessible for harvesting. Staff believe the areas in question to be either narrow bands of timber above existing blocks but below the current operability line, or areas unlikely to ever be harvested due to access constraints. A map review of four landscape units indicated that three percent of the timber harvesting land base in each of the reviewed landscape units, for a total of 1276 hectares, is within this category of questionable operability. Staff confirm that these areas do not overlap with the areas recently included in the timber harvesting land base as a result of the TCB project. Other landscape units within the TSA have not yet been reviewed, but staff believe that additional areas may be identified.

District staff conclude the additional 3800 hectares identified in the AFA technical submission should be included in the timber harvesting land base for the TSA. However, exclusion of the area from the TCB project that is now considered to be inoperable, as well as exclusion of the inaccessible areas as described above, results in a net overestimation in the analysis of the size of the timber harvesting land base by approximately 0.5 percent or 940 hectares.

I note that operability lines are intended to be a reasonable approximation of the land base available for harvesting and are always subject to some uncertainty, particularly in mountainous terrain that dominates in the Arrow TSA. However, apart from the considerations noted in this section, I am satisfied from my knowledge of the criteria used that operability has been assessed appropriately with considerations for physical accessibility, economic viability, current market conditions and operational performance. I accept that some areas outside the current operability line are likely operable, as was indicated by the AFA review. However, it is equally likely that some areas described as operable are not actually so, as indicated by the district review of four landscape units, and the assessment of the TCB project areas. The results of these reviews illustrate the uncertainty around operability which exists in many parts of the province.

A sensitivity analysis in which the timber supply impacts of a 10 percent decrease in the size of the timber harvesting land base was assessed, and indicates that the base case initial harvest level could be maintained for one decade before declining to mid- and long-term level approximately 10 percent below the base case.

Public input from the Valhalla Wilderness Society provided some suggestions for the redefinition of operability criteria. Having reviewed that input and noting the adjustments I

have previously referenced in this section, I believe that this factor has received fair consideration at this time.

I accept that there may be a 0.5 percent overestimation in the size of the timber harvesting land base. While the timber supply impacts projected by the sensitivity analysis are in excess of the expected impact of excluding these areas, the results do indicate some sensitivity in the mid- to long-term. However, short-term timber supply is not impacted, and in any event the impact to mid- to long-term timber supply on account of this one factor is less than one percent. In this determination, I will take into account the risk of this overestimation and I will discuss this further under 'Reasons for decision.'

- sites with low timber growing potential

Sites with low productivity as a result of inherent site factors such as nutrient availability, exposure, excessive moisture, or that are not fully occupied by commercial tree species are excluded from the timber harvesting land base.

In the analysis for the Arrow TSA, minimum volume and site productivity criteria were used to identify low sites. A total of 12 481 hectares of Crown forest was identified as low site using the criteria, resulting in a 3448 hectare or slightly less than two percent exclusion on this account from the timber harvesting land base.

District staff confirm that the site index thresholds applied in the analysis are a reasonable reflection of sites considered to have low growing potential in the TSA.

I have reviewed the criteria used to exclude sites with low timber growing potential and note that they seem reasonable. For this determination, I accept that the minimum values applied to exclude sites with low timber growing potential reflect operational practices and constraints.

- environmentally sensitive areas

Environmentally sensitive area (ESA) data, which identifies areas sensitive to disturbance and/or with significant value for fisheries, wildlife, water or recreation resources, were collected during the 1970's for the Arrow TSA. ESA classifications of E1 (highly sensitive) or E2 (moderately sensitive) are used to exclude areas from the land base where more specific or detailed information is not available about a particular forest resource. ESA data were used in the analysis in combination with other information sources to derive land base reductions to account for sensitive or unstable soils. Larger reduction factors were applied in community and domestic watershed areas to account for the greater management constraints for soil stability in these areas.

Approximately 3100 hectares of area identified as highly or moderately sensitive for regeneration (Ep) were excluded in the analysis. Other ESA classifications were used to exclude wildlife habitat areas and areas of high recreation potential, and these reductions are discussed later in this rationale under the appropriate sections.

Terrain stability assessments, of various levels of detail, were completed for portions of the TSA between 1983 and 1998 and the resulting data was used in the analysis. District staff examined harvesting history for areas with terrain stability assessments, and determined a percentage for areas that had not yet been harvested. The terrain stability data was then used to identify and remove additional areas after the ESA reduction was applied. In total, 32 359 hectares were excluded in the analysis from the timber harvesting land base to account for sensitive soils.

The BCFS regional geomorphologist has since reviewed the assumptions applied in the analysis for areas with both ESA and terrain stability mapping and has concluded that the methodology used was overly constraining.

In the AFA technical submission, similar concern was expressed that the most constraining information for each area was used in the analysis. In their submission, the AFA applied an alternative methodology for the exclusion of areas which included using terrain stability B or C data, where available, in place of Es1 data. Also in their technical submission, the AFA expressed the opinion that the Es2 mapping was not accurate enough to be used to derive area exclusions, and as a result they did not apply any reductions to account for these areas. The combination of these two modified assumptions in their technical submission resulted in an increase of 7189 hectares in the size of the timber harvesting land base.

I have considered the input from the AFA and I acknowledge its work is an attempt to clarify their concern. In consideration of the information, I find that the overall methodology used to remove unstable areas in the BCFS analysis was indeed overly constraining, and that it has led to an underestimation in the size of the timber harvesting land base. However, I do not accept the AFA argument that all Es2 areas should be included in the timber harvesting land base. From my review of the information and discussions with district staff, I am satisfied that some reduction to account for management in Es2 areas is appropriate given operational practice in these areas.

Having reviewed the methodologies in both the AFA and BCFS analysis with staff, I conclude that it is likely that the timber harvesting land base has been underestimated by some amount on account of this factor. However, I am not prepared to reflect the full 7189 hectares as noted in the AFA analysis, given my earlier observation that not all the Es2 areas should be considered operable and also given the need to further refine the relationship between the terrain stability assessments and the ESAs—as referenced earlier. Accordingly and based on my review with staff, I am prepared to reflect an underestimation in the size of the timber harvesting land base of 4300 hectares (of the 7189 hectares) at this time. I will discuss this factor further under 'Reasons for decision.'

I request that district staff work to ascertain the relationship between the ESA data and terrain stability information prior to the next determination for the Arrow TSA. Data from the terrain stability mapping is considered to be the most accurate available information, in particular given the age of the ESA inventory, the level of approximation associated with it and the lack of detailed field assessments accompanying ESA classification to provide verification. If it is not possible to clearly describe the appropriate relationship between the two datasets, I suggest that only the terrain stability information be used in the next timber supply review. Results from other management units indicate that better information is generally represented by the use of the more detailed terrain stability assessments rather than the highly generalized ESA assessments.

- problem forest types

Problem forest types are typically defined as stands which are physically operable and exceed low site criteria and yet are not currently utilized or have marginal merchantability. These types are either wholly or partially excluded from the timber harvesting land base in the analysis. In the Arrow TSA, problem forest types tend to be stands greater than 140 years of age with high levels of decay.

For the analysis, a sample harvest period from 1995-1997 was reviewed to determine which inventory type groupings to exclude as problem forest types. A total of 1102 hectares of balsam, pure hemlock, lodgepole pine and western redcedar stands were excluded from the timber harvesting land base on this account.

During the previous analysis for the Arrow TSA, hemlock-leading and balsam-spruce stands greater than 140 years of age—correlating to inventory type groupings 13 to 17, and 20—were 30 and 20 percent excluded, respectively. However, for the 2000 timber supply analysis, these stands were entirely retained in the timber harvesting land base.

District staff now recognize that not all of these older hemlock-leading and balsam-spruce stands are merchantable in current practice. Licensees have shown a reluctance to propose a significant amount of harvest in these types in recent Forest Development Plan (FDP) submissions. The sample harvest period used to develop the analysis assumptions covered an extraordinarily high pulp market, and as well licensees were requested by district staff to attempt harvest in these stand types during that time.

District staff believe that the percentage reductions applied in the previous timber supply analysis more appropriately reflect the merchantability of these stand types, with accounting for periodic performance across market cycles. Applying the percentage reductions from the 1994 analysis to the stands in question indicates a 4616-hectare overestimation in the size of the timber harvesting land base.

Prior to this determination, I observed some of these stand types in the field and I agree with district staff that not all of these stands are merchantable. I am satisfied that it is appropriate to take into account the timber supply impacts of excluding a portion of these stands as was done in the previous timber supply analysis. This exclusion equates to approximately two percent of the timber harvesting land base, and I will discuss this further under 'Reasons for decision.'

I suggest district staff continue to review the criteria used for defining problem forest types, and monitor performance in these stands over the term of this determination.

- deciduous species

Deciduous forest types are those stands dominated by deciduous broad-leaved species. Such stands were excluded from the timber harvesting land base, for a total reduction of 8340 hectares. In addition, all volume from deciduous broad-leaved species in stands of predominantly coniferous species, was excluded from the volume estimates.

District staff confirm that deciduous broad-leaved species are not currently utilized in the Arrow TSA. They note that demand exists for flooring quality logs, but that in general the stands in the TSA do not provide many logs of sufficient quality. Future opportunities may arise for the utilization and management of deciduous species in specific areas.

I am satisfied that the analysis assumptions with respect to deciduous species appropriately reflect current practice. Any operations in these stands which occur over time can be factored into future analyses.

- roads, trails and landings

In the analysis, a percentage of the productive forested area was excluded to account for the permanent loss of productive land to roads, trails and landings. Separate estimates are made for existing and future structures, to reflect both potential changes in road building practices

and road network requirements over time. Estimates account for the area that is permanently removed from the timber harvesting land base.

To account for existing roads in the Arrow TSA, an average right-of-way width was applied to the total length of roads depicted in the inventory file. Existing trail lengths were also calculated from the inventory file and an average width applied. To account for productivity loss as a result of existing landings, district staff reviewed year-end disturbance reports to derive an estimate of 3 percent of the timber harvesting land base. A total of 5241 hectares was excluded to account for existing roads, trails and landings in the analysis.

It was assumed that stands 40 years of age and younger had harvesting history and existing road networks that were accounted for as described above. To account for future roads, trails and landings, reductions were applied to stands 41 years of age and older after the first projected harvest of each stand. District staff calculated loss factors of 3 percent for roads, 2 percent for trails and 2.4 percent for landings from a review of year-end disturbance reports. The total area excluded from the timber harvesting land base over the analysis horizon to account for future roads, trails and landings was 11 702 hectares.

The Slocan Valley Watershed Alliance and the Valhalla Wilderness Society expressed concern about the reductions applied for future trails, indicating that there should be some additional accounting for the compaction resulting from the use of harvesting and site preparation equipment as well as for landslides caused from road construction. The Alliance also felt the value applied to account for existing trails was low.

The AFA also commented on the reductions applied for trails, stating that the assumed widths may be excessive, and in particular that the future trail deduction seems higher than indicated by data. They note that total values applied in other management units to account for future roads, trails and landings are in the range of four percent, and contend that current rehabilitation practices indicate a total reduction of one percent to account for future trails would be more reasonable. However, the AFA did not provide any specific data to support the values suggested.

District staff have reviewed the varied public input, in which it is suggested that the reductions used in the analysis to account for trails were either too large or too small. However, staff believe that the information used to derive the deductions for trails, while subject to some uncertainty, is the best available information at the current time. Staff note that trail rehabilitation has occurred, but only in recent history and is thus not extensive enough to warrant decreasing the percentages on this account. Staff hope that they may be able to conduct a field verification to validate assumptions and data for roads, trails and landings prior to the next timber supply review.

I have reviewed the information about roads, trails and landings, and am satisfied that the data used to account for existing structures represents the best available information. With respect to the exclusions applied for future roads, trails and landings, I am satisfied that there is no undue risk posed to timber supply as a result of any small uncertainties in the data. In any event, uncertainty about estimates for future roads, trails and landings affects timber supply only in the very long-term. I encourage licensee and district staff to continue to collect data so that the methodology and percentages can be refined for the next timber supply analysis. For this determination, I am satisfied that the accounting for this factor in the analysis was reasonable and reflective of current practice.

- timber licence reversions

Timber licences (TLs) are old tenure arrangements that give a licensee exclusive rights to harvest merchantable timber within the licence area. Once these areas have been harvested and reach a free growing condition, all future harvesting rights revert to the Crown and future harvests from the area contribute to the harvest for that TSA which contains the TL.

There are 817 hectares of TLs in the Arrow TSA. All of the TL areas are anticipated to be harvested before the expiry of the tenures in 2025. In the analysis, a reversion schedule approximated the return of these areas to the timber harvesting land base over a 45 year period.

I am aware that the analysis assumptions did not completely reflect current practice, as the TL areas are expected to revert over the next 25 years rather than the 45 years assumed in the analysis. Having reviewed the information, I note that this slight discrepancy results in approximately 145 hectares reverting to the TSA 20 years sooner than assumed in the analysis. I am satisfied that this difference is so small as to have a negligible effect on timber supply, and make no adjustments in this regard.

- woodlot licences

The *Forest Act* requires AACs determined for TSAs to be exclusive of the timber supply contribution from areas in woodlot licences. When a woodlot licence is initially issued, the associated harvest level is part of the AAC for the TSA as the woodlot is still part of the TSA. In the subsequent AAC determination for the TSA, the area of Crown land held in woodlot licences and the associated timber supply is excluded from contributing to the AAC for the TSA.

There are 13 existing woodlots in the Arrow TSA, covering 6647 hectares and with an associated volume of 12 015 cubic metres. All of these woodlots have been issued since the previous determination for the TSA.

In the analysis, the initial harvest level was set at the current AAC less 9700 cubic metres. The land base in the analysis was also reduced by 6500 hectares to account for the area attributable to woodlot licences.

I have reviewed the information and note that the total area associated with woodlot licences accounted for in the timber supply analysis was short by 147 hectares. Given this small discrepancy will have an insignificant impact on the timber supply forecast, I am not making any further adjustments on this account at this time. However, I am mindful that the analysis assumptions regarding woodlot volumes were also not entirely reflective of current practice, as the currently issued volume was underestimated by 2315 cubic metres per year. I believe that it is appropriate to take into account this additional reduction in the TSA's harvest level over the analysis horizon, and will discuss this further under 'Reasons for decision.'

- newly protected areas

Government released *A Protected Areas Strategy for British Columbia* in 1993, which describes the policies and process to protect 12 percent of the province. The strategy has two goals: representativeness (Goal 1) which protects viable examples of the natural diversity of the province, and special features (Goal 2) which protect the special natural, cultural heritage and recreational features of the province.

The 1995 KBLUP proposed eight new Goal 1 protected areas covering over 11 percent of the region, which were designated as parks in 1998. Portions of four of these protected areas—

Granby, Gladstone, Goat Range and Syringa—are located within the Arrow TSA and were excluded from the timber harvesting land base.

The 1995 KBLUP also stated that a local planning process would identify a further portion of the region for protection of small Goal 2 sites, which are generally between 25 and 100 hectares in size. Of the new parks and protected areas designated under the strategy, portions of six are in the Arrow TSA. The proposed protected areas encompass approximately 1761 hectares of Crown land in the district, although an estimate of the area which falls within the timber harvesting land base of the TSA is not yet available. None of these new protected areas have been officially approved through orders in council, and therefore there was no accounting for their removal in the timber supply analysis. Operationally, the Goal 2 areas are deferred from harvest, and no harvesting activity within these areas is anticipated to take place in the near future.

From discussions with district staff regarding these areas, I am also satisfied that management of the areas is being handled at the operational level in a manner consistent with their intended status, and that the resource values are not at risk. The total land base in the Arrow TSA impacted by these areas is small, and as well I believe that future removal of these areas will not pose a great risk to timber supply for the TSA.

I have reviewed the information and I am satisfied that there has been an appropriate accounting for designated protected areas in the timber supply analysis. Once the Goal 2 areas identified under the PAS become officially designated, they can be excluded from contributing to timber supply in a future determination.

Existing forest inventory

The inventory data used for the timber supply analysis is based on a forest inventory completed in 1974 for the Salmo Public Sustained Yield Unit (PSYU), and in 1977 for the rest of the Arrow TSA. For the analysis, the inventory was updated to 1998 to account for growth, disturbances such as harvesting, road-building and fire, and for silvicultural treatments.

To address uncertainties identified in the last AAC determination, I directed BCFS staff to complete an inventory audit prior to this analysis, which has now been completed. The results of the audit indicate that the inventory volumes for the TSA are acceptable. I will discuss the results of the audit further under *volume estimates for existing stands*.

The forest inventory for the Arrow TSA is one of the oldest in the province and district staff are currently pursuing funding to complete a new inventory. District staff state that the age of the inventory creates some uncertainty about the volumes and species composition described for existing stands by the inventory data.

Although I am aware of the concerns of the district, I note that the audit results indicate the inventory volumes on the whole are acceptable, and therefore for this determination I accept that the inventory provides the best information available from which to determine volume estimates.

However, I am fully supportive of the district's assessment that a new forest inventory is a high priority for the Arrow TSA. I recognize that inventories are costly and that funding for such a large project is limited. Consequently, I strongly encourage district staff to pursue agreements or partnerships with the TSA licensees, through the Innovative Forest Practices Agreement (IFPA) or FRBC, to secure funding for this project. It is essential that the information on

which so many forest management decisions are based, be upgraded to a level which provides a greater level of certainty for application by both licensees and government.

- age class composition

Only 4 percent of the stands on the forested land base of the Arrow TSA are currently older than 250 years of age, which has implications for biodiversity management as discussed under *landscape level biodiversity*.

Of the stands on the timber harvesting land base, approximately 15 percent are 20 years of age or younger, a further 48 percent are between 21 and 100 years of age, and 34 percent are between 101 and 250 years of age. Only 3 percent of the stands on the timber harvesting land base are 250 years of age or older. However, over 62 percent of the stands in the Arrow TSA are currently older than minimum harvestable age.

I have reviewed the information on age class composition and accept it as a reasonable reflection of the age class distribution of the TSA.

- volume estimates for existing stands

Volumes for existing natural stands (in which species and stocking have not been managed) were estimated and projected using forest inventory attributes and the Variable Density Yield Prediction (VDYP) model which was developed by the BCFS Resources Inventory Branch.

All Douglas-fir and predominantly spruce stands older than 20 years of age, and other stands older than 10 years of age were assumed to be unmanaged. After a stand was projected for harvest for the first time in the analysis, future growth and yield was estimated using managed stand yield tables.

At the previous determination, district staff expressed concern that volumes for existing hemlock, western redcedar and balsam stands were overestimated by the forest inventory data. As mentioned under Existing forest inventory, an audit has since been conducted on the inventory for the Arrow TSA, assessing differences between the existing inventory's estimate of mean mature volume per hectare for the TSA and a new estimate obtained from the audit samples. The results of the audit for the mature component of the inventory suggest that the inventory volumes, which reflect those used in the analysis, are statistically acceptable for the land base as a whole.

Public input from the Valhalla Wilderness Society questioned the existing stand volumes and whether the operational tendency for higher volume stands to be harvested first is reflected in the analysis. BCFS staff confirm that this is accounted for in the methodology used in the analysis to derive stand volume estimates.

District staff have reviewed the volume estimates for existing natural stands assumed in the analysis. Notwithstanding the concern mentioned under Existing forest inventory about the age of the inventory, they state that the inventory data provides the best available information on which to base existing stand volume estimates. As mentioned in that section, I fully support efforts of district staff to obtain necessary funding for re-inventory work in the TSA.

I have reviewed the information about existing stand yields, including the results of the inventory audit, and conclude that the existing natural stand yields as projected using the inventory and VDYP are suitable for use in this determination.

Expected rate of growth*- site productivity estimates*

Inventory data includes estimates of site productivity for each forest stand, expressed in terms of a site index. Site index is based on the stand's height as a function of its age. The productivity of a site largely determines how quickly trees grow, which in turn affects the time seedlings will take to reach green-up conditions, the volume of timber that can be produced, and the ages at which a stand will reach a merchantable size.

In general, in British Columbia, site indices determined from younger stands (i.e. less than 31 years old), and older stands (i.e. over 150 years old) may not accurately reflect potential site productivity. In young stands, growth often depends as much on recent weather, stocking density and competition from other vegetation, as it does on site quality. In old stands, which have not been subject to management of stocking density, the trees used to measure site productivity may have grown under intense competition or may have been damaged, and therefore may not reflect the true growing potential of the site. This has been verified in several areas of the province where studies—such as the Old-Growth Site Index (OGSI) 'paired plot' project and the 'veteran' study—as well as results from using the Site Index Biogeoclimatic Ecosystem Classification System (SIBEC) suggest that actual site indices may be higher than those indicated by existing data from old-growth forests. In recent years it has been concluded from such studies that site productivity has generally been underestimated by the inventory file data; managed stands tend to grow faster than projected by inventory-based site index estimates from old-growth stands. In the Arrow TSA, site productivity estimates for 15 percent of the timber harvesting land base are derived from data from stands older than 140 years of age.

No local studies have been completed in the TSA to assess the accuracy of the site productivity estimates. However a study being conducted under the IFPA is expected to provide better estimates of site productivity for younger stands following its completion early in 2001.

Given the lack of available local data, no site productivity adjustments were applied in the base case forecast. The potential impacts to timber supply from adjusted site indices were assessed by applying generalized site index adjustments in a sensitivity analysis, based on data from both paired plot and veteran studies. The adjustments were applied to sites currently covered by Douglas-fir, western redcedar, hemlock, balsam, spruce and lodgepole pine stands greater than 140 years of age. In the sensitivity analysis, managed stand volume estimates, green-up ages and minimum harvestable ages were recalculated based on adjusted average site productivity. The analysis results showed that timber supply could increase to 597 000 cubic metres per year after decade nine, a level approximately 9 percent higher than that of the base case. In the long-term, timber supply was 7 percent greater than projected in the base case.

These results indicate that the mid- to long-term timber supply in the Arrow TSA is sensitive to the possibility of increased site productivity for managed stands. In respect of cautions expressed in the OGSI study I consider that the sensitivity forecasts provide an indication of general trends rather than an accurate and precise projection of timber supply. The collection of local data would help to remove uncertainty and allow for a more precise assessment of this factor. However, in spite of uncertainty about the precise magnitude of any underestimation, I conclude that the inventory data leads to underestimations of site productivity for some regenerating stands in the TSA. These underestimations in site productivity lead to an

unquantified upward influence on timber supply in the long-term, and may act to stabilize mid-term timber supply when considered in combination with other factors acting to decrease timber supply. My considerations of this will be discussed further in 'Reasons for decision.'

I look forward to reviewing the results of the study being undertaken through the IFPA, as well as the results of any other studies that may be initiated, such that localized data can be factored into future timber supply analyses.

- volume estimates for managed stands

To estimate volumes for managed stands, the BCFS uses the Table Interpolation Program for Stand Yields (TIPSY), developed by the BCFS Research Branch. For the Arrow TSA analysis, managed stands were defined as all stands of predominantly Douglas-fir or spruce species 20 years of age or less, all other stands 10 years of age or less and all stands which will be harvested in the future. In the analysis, volumes from managed stands were projected to begin contributing to the harvest in the seventh decade. Operationally, managed stands are not yet harvested in the TSA.

The uncertainty in the site productivity information discussed in the previous section of this rationale also impacts managed stand yield estimates. The sensitivity of timber supply to uncertainty in managed stand yields was tested in the analysis by increasing and decreasing managed stand yield estimates by 10 percent. When managed stand volumes were increased by 10 percent, the timber supply was increased in decade seven by about 10 percent over the mid-term level projected in the base case. When managed stand volumes were decreased by 10 percent, timber supply decreased in decade seven to a level approximately 10 percent below the mid-term level projected in the base case.

I have reviewed the information regarding managed stand yield estimates. Subject to the considerations discussed previously about site productivity estimates, I am satisfied that reasonable procedures were followed in the analysis, and make no adjustments in this regard.

- operational adjustment factors

TIPSY projections are initially based on ideal growing conditions, assuming full site occupancy and the absence of pests, diseases and significant brush competition in the stand. Certain operational conditions, such as less than ideal tree distribution, small non-productive areas, endemic pests and diseases, or age dependent factors such as decay, waste and breakage may cause yields to be reduced over time. In timber supply analysis, operational adjustment factors (OAFs) are applied to yields generated using TIPSY to account for losses of timber volume as a result of these operational conditions. OAF 1 can account for factors affecting the yield curve across all ages, such as small stand openings. OAF 2 can account for factors whose impacts tend to increase over time, and whose influence on a stand may be reduced through management practices, such as pests, disease, decay, waste and breakage.

In the analysis, the standard provincial reductions of 15 percent for OAF 1 (accounting for less than ideal tree distribution, small non-productive areas, endemic pests and disease, and random risk factors such as windthrow), and 5 percent for OAF 2 (accounting for decay, waste and breakage) were applied.

There are two influences on managed stands in the Arrow TSA for which there may not have been adequate accounting in the OAF values used in the analysis, and these are discussed below.

1) *armillaria*

Armillaria ostoyae (armillaria) is a root disease which forms a component of most managed and natural forest stands in the southern third of British Columbia, including those of the Arrow TSA. The root disease is expected to affect the vigour, stocking levels and species composition of second-growth stands, although limited information is available on the timber supply impacts of the disease.

In the previous timber supply analysis, I requested that district staff 'quantify the impact of Armillaria root rot on stand volumes and green-up periods prior to the next AAC determination.' The Nelson Forest Region forest pathologist has since prepared a report using data collected in the Kootenay Lake TSA (adjacent to the Arrow TSA). The report suggested OAF 2 values to account for losses as a result of armillaria, but no assessments were made as to the extent and severity of the disease in either the Arrow TSA or in the adjacent TSA. A BCFS Timber Supply Branch and Forest Practices Branch staff review of the results of the study concluded that, although the information in the report is useful, it does not substantiate specific OAF values to account for armillaria at this time. The regional project has been extended in order to answer several outstanding questions.

The Slocan Vailey Watershed Alliance and the Valhalla Wilderness Society expressed concern about the accounting in the analysis for root disease, believing that the standard reductions were not adequate. BCFS staff agree that additional accounting is likely warranted, but note that the information available thus far is not sufficient to provide an indication of the appropriate reduction to account for armillaria losses.

To test the sensitivity of timber supply to higher volume losses as a result of armillaria, OAF 2 values were adjusted from 5 percent to either 15 or 20 percent, using criteria of species and site index. The results indicate a mid- to long-term timber supply impact is likely if OAF 2 values were within the range tested.

I have reviewed the information and recognize that there is some uncertainty about the impact armillaria root disease may have over time on the timber supply in the Arrow TSA. I concur that additional data is required to provide more precise accounting for this factor. In any event, the sensitivity analysis results indicate that short-term timber supply is unaffected by this factor alone.

For this determination, I accept that there is an unquantified downward pressure on mid- to long-term timber supply on this account, and I will discuss this influence and the risks to timber supply further in my 'Reasons for decision.'

Prior to the next determination, I request that BCFS staff continue to collect the data necessary to better quantify volume impacts in managed stands as a result of armillaria root disease.

2) *leader weevil*

An additional forest health concern is *Pissodes strobi*, a leader weevil which affects spruce species in younger predominantly spruce stands at mid to lower elevations in the TSA. Limited data is available on the longer term impacts of the weevil on stand volumes and timber supply.

A report conducted for the Nelson Forest Region in 1995 indicated that up to 83 percent of the spruce stands planted between 1969 and 1989 in the Arrow Forest District had sustained some weevil damage. Approximately 8400 hectares or 4 percent of the timber harvesting land base

is occupied by spruce stands that are 20 years of age or younger and are potential targets for weevil. Weevil damage affects the quality of the stems in a stand, but the impact on overall stand volumes is not clear, and it is uncertain what volume reduction might be appropriate to apply to affected stands. BCFS staff indicate that a volume reduction of 10 percent has been applied to affected stands in other management units, such as the Robson Valley TSA, to account for weevil damage.

I have reviewed the information and accept that it is appropriate at this time to provide some additional accounting for the impacts of leader weevil, given the quantified information on its incidence in the TSA. In the absence of specific localized information about volume impacts, I am satisfied that the suggested volume reduction of 10 percent to affected stands likely provides a more reasonable approximation of the impact in the Arrow TSA. I will discuss this further under 'Reasons for decision.'

Subject to the availability of resources given the relatively small area involved in the TSA, I suggest that any additional information which could help in the estimation of timber supply impacts resulting from weevil damage be collected, so that the information can be used in future analyses for the Arrow TSA.

- improved seed

The Forest Practices Code requires the use of improved (class A) seed from seed orchards for regeneration where available. Class A seed are produced in BC's tree improvement programs, which use traditional plant breeding techniques to select naturally occurring, healthy, vigorous and well performing trees.

Trees from class A seed grow faster than those from natural stand seed for a specific time which varies by species and site. As a result, a stand composed of trees from class A seed has a greater volume at the same age than a natural stand with the same species composition. Current expectations are that the volume differences will begin to decrease beyond a certain stand age.

No adjustments were applied to account for the use of class A seed in the base case forecast. Instead, potential timber supply benefits were assessed through sensitivity analysis, in which adjustments were applied to the minimum harvestable ages, green-up ages and volumes of the white spruce, lodgepole pine, and Douglas-fir component of managed stands. The results, which indicated a slight increase in mid-term harvest levels, and a 5.7-percent increase in the long-term harvest level, are consistent with trends shown in other management units.

However, district staff believe that the sensitivity analysis assumptions regarding the use of class A seed are in excess of what would be realized in current practice. The availability of class A seed for the sites in the Arrow TSA is currently limited to spruce and to a lesser extent larch seed, and over the past three years only 18 percent of total planting has used seedlings from class A spruce seed. None of the managed stands were assumed to be regenerated with improved seed in the analysis.

In their technical submission, the AFA included adjustments to reflect the expected genetic gain in their base case assumptions, stating that the adjustments approximate the use of class A seed in current practice.

Although the production, availability and use of class A seed is not presently consistent with that assumed in the sensitivity analysis, the results do provide me with an assessment of the potential benefits for timber supply. From review of the information, I am satisfied that the base case assumptions do not reflect the current practice for class A seed. As a result, I believe

that timber supply is slightly greater in the mid to long term than projected in the base case on this account, and will discuss this further in 'Reasons for decision.'

- minimum harvestable ages

A minimum harvestable age is an estimate of the earliest age at which a forest stand has met minimum merchantability criteria. The minimum harvestable age assumption largely affects when second growth stands will be economically available for harvest. In practice, many forest stands are harvested beyond the minimum harvestable age due to constraints on harvesting which arise from managing for other forest values such as visual quality, wildlife and water quality.

In the analysis for the Arrow TSA, minimum harvestable ages for managed and unmanaged coniferous stands were set at the age at which an average merchantable volume of 150 cubic metres per hectare, and at which a diameter at breast height (dbh) of 25 centimetres, were expected to be attained. The criteria were developed by district staff using their knowledge of existing harvesting operations, and the age varied depending on species and silvicultural treatment regimes. The derived minimum harvestable ages ranged between 50 and 90 percent of the culmination age for the stand.

Public input from the Valhalla Wilderness Society questioned the shift in minimum harvestable ages from culmination age to the age of minimum economic yield. I note that minimum harvestable age should not be interpreted as the target age at which a stand *should* be harvested, but rather as the minimum age at which a stand *could* be harvested, in balance with all other management considerations for the land base, such as for biodiversity, visual quality, wildlife habitat and water quality. The average age at which stands were harvested in the analysis ranged from 175 years at the start of the modelling to 110 years by decade 20. In general, it is expected that it was not necessary to harvest stands at their minimum harvestable ages in order to maintain the base case harvest forecast.

However, district staff indicate that they are not certain the assumptions for minimum harvestable ages are entirely reflective of current practice, and suggest that setting ages at 95 percent of culmination age (the age at which the maximum annual volume increment is attained) may be more reflective. Sensitivity analysis conducted to assess the impacts of uncertainty in minimum harvestable ages indicate mid-term timber supply is impacted if the ages are increased to culmination age. However, timber supply is not affected when minimum harvestable ages are increased to 95 percent of the culmination age of the stand.

Having reviewed the information regarding minimum harvestable ages, I am satisfied that there is some residual uncertainty around minimum harvestable ages, and that an age reflecting 95 percent of the culmination age of the stand may more appropriately reflect current operations in the TSA. I will discuss this further under 'Reasons for decision.'

- (ii) the expected time that it will take the forest to become re-established on the area following denudation,

Expected time for forest to be re-established following harvest

- regeneration delay

Regeneration delay is the period between harvesting and the time at which an area becomes occupied by a specified minimum number of acceptable, well-spaced seedlings. In timber

supply analysis, regeneration delay is used to determine the starting point of tree growth for the yield curves which project volumes over time.

In the analysis for the Arrow TSA, all harvested areas were assumed to be planted within two years of harvest. The estimate was based on a review by district staff of the previous ten years of performance, and was confirmed by major licensees.

In the 1995 determination, regeneration delays of between 3 and 9 years were assumed, an estimate which included an accounting for regeneration delays associated with difficult-to-regenerate backlog areas. However, as discussed under *not-satisfactorily-restocked areas*, regeneration assumptions for backlog areas were treated separately in the most recent timber supply analysis.

The AFA in their technical submission noted that the age of the planting stock should have been deducted in the modelling, as regeneration delay in timber supply modelling is measured from when the seed begins to grow. Timber Supply Branch staff agree with the input, which would indicate an overestimation of regeneration delay in the analysis by one year. However, district staff indicate that there are some small areas covering up to 10 percent of the TSA in which natural regeneration is allowed to occur, resulting in slightly longer regeneration delays. This consideration was not explicitly modelled in the analysis. Overall, district staff state that the two year regeneration delay assumed in the analysis is a good reflection of current practice.

I note that any small overestimation in regeneration delay has been shown in analyses to not significantly impact timber supply. I request that district staff monitor trends in regeneration delays such that any refinements in the data can be incorporated into future analyses. From review of the information, I am satisfied that I do not need to make any further adjustments with respect to this factor in this determination.

- impediments to prompt regeneration

Any significant impediments to prompt regeneration must be accounted for in the timber supply analysis. In the Arrow TSA, district staff indicate that there are no impediments to prompt regeneration beyond those already accounted for in the regeneration delay assumptions used in the analysis. They believe the analysis assumptions appropriately reflect current practice in the TSA.

I have reviewed the information regarding impediments to prompt regeneration and am satisfied that the assumptions are acceptable for this determination.

- not-satisfactorily-restocked areas

Not-satisfactorily-restocked (NSR) areas are those where timber has been removed, either by harvesting or by natural causes, and a stand of suitable forest species and stocking has yet to be established. Where a suitable stand has not been regenerated and the site was denuded prior to October 1, 1987, the classification is 'backlog' NSR.

'Current' NSR refers to those areas recently denuded and not yet restocked. In the analysis, it was assumed that all current NSR would be restocked within the regeneration delay time limits.

The Arrow TSA has approximately 2000 hectares of backlog NSR. Backlog NSR has been reduced significantly since the previous timber supply review. In the base case for the analysis, it was assumed that 70 percent of the backlog areas would be satisfactorily restocked within

the next ten years. The remaining 30 percent of backlog areas were assumed to be restocked gradually over the following 60 years.

The Slocan Valley Watershed Alliance and the Valhalla Wilderness Society questioned the assumptions around backlog NSR, believing restocking will occur at a much slower pace, particularly as reductions in funding continue. District staff respond that funding is currently available for backlog reforestation and that the assumptions for backlog NSR are believed to be reasonable. Other public input stated that the value for current NSR could not be valid, given the history of harvesting in the TSA. However, district staff are confident that the majority of harvested areas are restocked during the regeneration delay time limits.

I have considered the information, and I have no concerns about NSR assumptions which would require adjustments to the harvest forecast projected in the base case for this determination. I am satisfied that the best available information was used in the analysis.

(iii) silviculture treatments to be applied to the area,

Silvicultural treatments to be applied

- silvicultural systems

Most harvesting in the Arrow TSA has occurred through the use of clearcutting silvicultural systems. The majority of partial harvesting is group selection, although there has been some minor use of shelterwood, seed tree, and species selection systems in the TSA to date. Single tree species selection to remove lodgepole pine has been employed only to mitigate forest health concerns. Clearcut silvicultural systems were reflected in the analysis given that they are the main silvicultural systems in use in the TSA.

District staff indicate that harvesting has shifted over time to clearcuts with reserves, patch cuts and group selection harvesting, all of which involve the use of smaller cutblocks. Staff note that the application of these systems has led to the retention of trees in patches which are assumed to not impede the growth of adjacent regenerated stands. Requirements under the Forest Practices Code for riparian reserves and wildlife tree patch areas, as well as forest cover constraints related to green-up were also factored into the analysis and are discussed in the appropriate sections of this rationale.

District staff indicate that the analysis assumptions were an adequate reflection of current operational practice. Staff expect that the use of non-clearcut silvicultural systems will increase over time, as is the case with other management units across the province. However, they note that extensive use of partial cutting systems is limited by access, terrain, root disease issues and economics. Partial harvesting systems may not be suitable for use in areas where root disease is a concern, as research has shown their use may exacerbate forest health problems in the residual stand.

Public comments received from the Valhalla Wilderness Society and the Slocan Valley Watershed Alliance questioned the capability of the timber supply model to reflect the expected harvest from selection silvicultural systems. As mentioned above, the alternative silvicultural systems currently employed in the TSA result in the creation of openings which district staff believe are large enough that the growth of the regenerating stand is not projected to be impacted by the surrounding forest, and therefore no special treatment was applied in the modelling.

I have considered the information regarding silvicultural systems and note that there will likely be a shift in harvest projections in the future to reflect increasing use of alternative systems. For this determination, I accept that current practice has been adequately modelled, and make no adjustments in this regard. As better information becomes available and the capabilities of our modelling tools improve, future changes can be factored into subsequent analyses.

- incremental silviculture

Incremental silviculture includes activities such as commercial thinning, juvenile spacing, pruning and fertilization that are beyond the silviculture activities required to establish a free-growing forest stand.

1) juvenile spacing

Juvenile spacing involves cutting less desirable trees within a young stand to reduce competition among the residual trees for water, nutrients and sunlight. Trees cut during juvenile spacing are not usually removed from the site, and the volume does not contribute to timber supply. Spacing can have many potential benefits, including meeting biodiversity or wildlife habitat objectives, maintaining or enhancing forest health, managing species composition and stand structure, increasing stand value and offering employment opportunities for small operators.

In the Arrow TSA, the application of juvenile spacing is limited by the prevalence of armillaria root disease, the impacts of which may be exacerbated by spacing. District staff indicate that approximately 150 hectares of area is spaced per year when funding permits and suitable stands are available.

The base case for the analysis assumed a certain level of density control in existing and future managed stands. District staff indicate that the analysis assumptions reflect stand dynamics in the TSA.

Incremental silvicultural activities, where rigorous analysis shows them to be appropriate, are integral components to a good forest management to achieve both timber and non-timber objectives. There are many potential benefits and I encourage staff to pursue their silvicultural goals where funding is available. For this determination, I accept that current practice was appropriately reflected in the analysis.

2) commercial thinning

Commercial thinning is a partial cutting silvicultural system in which some volume is removed from an immature stand after components of the stand have reached a merchantable size. The volume removed during the commercial thinning is sold and therefore contributes to timber supply. Commercial thinning generally does not significantly affect overall volumes but may provide flexibility with respect to timing and location of harvest.

No commercial thinning activity was assumed in the timber supply analysis, as very little is conducted operationally in the Arrow TSA. District staff indicate that one active commercial thinning timber sale licence of 1200 cubic metres per year exists in the TSA, and the future potential of an additional four areas is under review.

In the previous determination, I requested that district staff give consideration to the application of commercial thinning in the Arrow TSA. District staff have since conducted a review to determine the extent of suitable sites. The review showed that few areas are suitable

for commercial thinning, due to one of or a combination of the following factors: insufficient stand volume, inappropriate stand structure, forest health concerns (armillaria), or difficult and costly access.

I accept the conclusion of district staff that the use of commercial thinning is likely limited in the TSA given current technology and the forest stand conditions prevalent in the TSA. I am satisfied that this issue needs no further investigation at this time. I accept that current practice has been appropriately reflected.

- rehabilitation programs

Stand rehabilitation is not a current practice in the Arrow TSA, and none was assumed in the analysis. Under the Arrow IFPA, rehabilitation of fume impact areas resulting from mining activity around the community of Trail is currently being considered. The major licensees estimate a gross area of 7876 hectares may be suitable for rehabilitation and they plan to install an operational trial during the next year. If the entire fume impact area is feasible for rehabilitation as estimated, the timber harvesting land base of the TSA could increase by 4 percent. However, district staff indicate that there is still much uncertainty, and believe that the area suitable for rehabilitation may be much smaller.

For this determination, I am satisfied that current practice was appropriately reflected. If areas are successfully treated in the future, their rehabilitation can be reflected in a future analysis.

- (iv) the standard of timber utilization and the allowance for decay, waste and breakage expected to be applied with respect to timber harvesting on the area,

Timber harvesting

- utilization and compliance

Utilization standards define the species, dimensions and quality of trees that must be harvested and removed from an area during harvesting operations. The standards used in the timber supply analysis were consistent with values applied regionally and in other southern interior units. District staff state that the assumptions regarding utilization standards appropriately reflect the levels of utilization required in current practice.

I have reviewed the information regarding utilization standards and I am satisfied that the assumptions used in the base case are reasonable, and make no adjustments in this regard.

- decay, waste and breakage

The VDYP model, which is used to project volume for existing stands, incorporates estimates of volume lost to decay, waste and breakage. Decay losses are built into the volume estimates, while standard waste and breakage factors are incorporated into the analysis when developing VDYP yield curves. These estimates of losses have been developed for different areas of the province based on field samples.

I am satisfied that standard procedures were followed to provide accounting for decay, waste and breakage factors, and am aware of no issues which would impact this determination.

- (v) the constraints on the amount of timber produced from the area that reasonably can be expected by use of the area for purposes other than timber production,

Integrated resource management objectives

The Ministry of Forests is required under the *Ministry of Forests Act* to manage, protect and conserve the forest and range resources of the Crown and to plan the use of these resources so that the production of timber and forage, the harvesting of timber, the grazing of livestock and the realization of fisheries, wildlife, water, outdoor recreation and other natural resource values are coordinated and integrated. Accordingly, the extent to which integrated resource management (IRM) objectives for various forest resources and values affect timber supply must be considered in AAC determinations.

- cutblock adjacency/green-up

To manage for resources such as water quality and aesthetics, current harvesting practices limit the size and shape of cutblocks and amount of disturbance (areas covered by stands of less than a specified height), and prescribe minimum green-up heights for regenerated stands on harvested areas before adjacent areas may be harvested. Green-up requirements provide for a distribution of harvested areas and retention of forest cover in a variety of age classes across the landscape.

The analysis for the Arrow TSA incorporated resource emphasis zones for caribou habitat, visual quality, community and domestic watersheds, regionally significant fish streams and ungulate winter range. Forest cover constraints were developed for each resource emphasis zone using time to green-up as determined from the report entitled *Age to Green-up: Using Regeneration Survey Data*. The constraints applied to account for management considerations in the various resource emphasis zones are discussed separately in this rationale under the appropriate sections.

The area remaining following the delineation of the specific resource emphasis zones—approximately 26 475 hectares or 13 percent of the timber harvesting land base—was assigned to the IRM zone. In the analysis, no more than 25 percent of the stands on the timber harvesting land base in the IRM portion of each landscape unit could be less than two metres in height at any one time.

The green-up height of 2.0 metres was applied in the analysis to the IRM, caribou and ungulate winter range resource emphasis zones, to reflect the KBLUP guideline for green-up. However, in the analysis a 2.0 metre inventory top height was used, instead of a 2.5 metre inventory top height (corresponding to a 2.0 metre silviculture height), the latter of which more appropriately reflects the KBLUP intent.

In sensitivity analyses, when green-up heights were adjusted from 2 metres to 2.5 metres for stands in the IRM, caribou and ungulate winter range zones (a one to three year increase in green-up ages) the harvest forecast was unaffected until decade four, where it experienced a 3-percent decline below the mid-term base case level. These sensitivity analysis results closely represent management under the requirements of the KBLUP and the Kootenay-Boundary Higher Level Plan Order.

As further discussed under *landscape level biodiversity*, direction under the KBLUP includes management for patch size distribution. To reflect this, an additional constraint was applied in the IRM zone. Under this constraint, a maximum of 30 percent of the stands on the timber harvesting land base could be less than 40 years of age at any one time. Sensitivity analysis in

which this constraint was removed indicated timber supply is not constrained by this additional requirement.

The AFA expressed concern about this additional forest cover constraint applied in the base case of the analysis. They suggest that the hydrological objectives that gave rise to the additional constraint can be regulated by the standard forest cover constraints applied in the analysis. However, district staff believe that the constraints applied are a reasonable reflection of the expected management outside consumptive-use watersheds at this time.

I am aware that this additional forest cover constraint was applied in an attempt to emulate considerations which guide current operational planning in the district, and also to be consistent with the Kootenay-Boundary Land Use Plan.

Having reviewed the concerns that were raised, and the district staff's response, I reason as follows. Timber supply exhibited low sensitivity to this additional constraint. Given this, and the fact that the additional constraint in the analysis was applied in an attempt to approximate operational and land use considerations that range from managing biodiversity aspects such as patch size and connectivity through to hydrological considerations—for which modelling procedures are expected to improve in the future—I am making no further adjustments on account of this factor at this time.

Having considered the information around adjacency and green-up, I am mindful that the range for which green-up ages were underestimated, sensitivity analysis shows that only mid- to long-term timber supplies are sensitive to the difference. I am mindful of the risks posed to timber supply on account of this factor, and will discuss this further under 'Reasons for decision.'

I expect that research and operational implementation of requirements for patch size and connectivity will provide greater clarity for modelling these considerations for the next analysis for the TSA.

- visually sensitive areas

Careful management of scenic areas along travel corridors and near recreational sites is an important IRM objective. The Forest Practices Code enables the management of visual resources by providing for scenic areas to be identified and made known by the district manager or through a higher level plan, and by providing for the establishment of visual quality objectives (VQOs). A visual landscape inventory identifies, classifies and records visually sensitive areas within a landscape. Using such an inventory, recommended visual quality classes (RVQCs) of preservation, retention, partial retention or modification may be derived to guide operational practices. These recommended VQCs may become VQOs established by the district manager or through a higher level plan.

Management for visual quality applies to the Crown forested land within scenic areas. In the Arrow TSA, scenic areas were officially made known by the district manager in June 1998. VQOs have not yet been established. However, the district manager has requested that licensees follow the recommended VQCs of either retention, partial retention or modification from the 1994 Mirkwood visual landscape inventory.

To achieve objectives for visual quality, limits are placed on the amount of visible disturbance that is acceptable in visually sensitive areas. These limits act to constrain timber harvesting, road building and other forest practices. Guidelines to meet VQOs include setting a maximum percentage of a visual landscape allowed to be in a disturbed state at any one time, and setting visually effective green-up (VEG) targets that must be achieved before additional harvesting is

permitted. VEG refers to the stage at which a stand of forested timber is perceived by the public to be satisfactorily greened-up from a visual standpoint.

Provincial guidelines provide a range of values for maximum disturbance in each visually sensitive area. The applicable disturbance value within the range is dependent on the visual absorption capacity (VAC) of the area, which is a measure of an area's physical capacity to absorb alterations while maintaining its visual integrity. An area with a low VAC can sustain relatively less disturbance than an area with a high VAC before the visual condition is compromised.

In the timber supply analysis for the Arrow TSA, approximately 140 355 hectares, or 35 percent of the entire productive forest was located within known scenic areas and considered to be visually sensitive. The visually sensitive areas cover 38 percent of the timber harvesting land base, the majority of which is classified as partial retention. In the analysis, zones were created for the specific areas using the RVQCs, and the constraints were applied as the maximum percentage of productive forest area within each landscape unit that could be occupied by stands less than a certain height.

The restrictions for green-up were applied to the entire productive forest land base because disturbance restrictions in visual areas apply to the entire viewscape regardless of operability. Values for maximum percentage of disturbance which would reflect those applied in current practice were determined using provincial guidelines for factoring visual resources into timber supply analyses. For the Arrow TSA analysis, district staff recommended modelling permissible disturbance at the maximum of the indicated ranges, as visual landscape design techniques are practised in the TSA.

The percentage of the productive forest area that could be less than a specified height at any one time was as follows:

- for the retention VQO zone, no more than 5 percent of the area could be less than 7 metres in height;
- for the partial retention VQO zone, no more than 15 percent of the area could be less than 7 metres in height; and
- for the modification VQO zone, no more than 25 percent of the area could be less than 6 metres in height.

These assumptions imply that all the areas classified as visually sensitive have a high capacity to absorb disturbance.

District staff state that harvesting is occurring within the scenic areas in operational practice. For the majority of the TSA, operations are within the recommended VQCs for the area. However, district staff now believe that some of the assumptions applied in the base case forecast are subject to some uncertainty, as discussed below.

In their technical submission, the AFA questioned the calculation of the six and seven metre green-up heights for visually sensitive areas applied in the analysis. They state that the calculation of green-up heights should be based on area weighted slopes by recommended VQC within the timber harvesting land base, rather than within the Crown forested area as was done in the analysis. BCFS staff agreed with the comment, and note that the result is a small reduction in the green-up heights for each zone which, when evaluated, has little impact on timber supply.

Some uncertainty also exists around the maximum allowable disturbance values used in the analysis. Current policy typically followed in timber supply analysis is to model the

permissible disturbances to the midpoint of the allowable range, rather than the maximum for that range indicated in the guidelines, where there is no current practice—such as visual landscape design—to indicate otherwise. Modelling to the midpoint of the range assumes a medium VAC for the areas. For the Arrow TSA analysis, a high VAC was assumed, although staff now believe a medium VAC is more reflective of actual practice.

Sensitivity analysis to assess the impacts of assuming medium VAC for visually sensitive areas indicates reductions in mid- to long-term timber supply. Short-term timber supply is unaffected, but mid-term harvest levels are 5 to 13 percent lower and long-term timber supply is 10 percent lower than the levels projected in the base case. In the analysis, all visually sensitive areas with the same RVQCs were aggregated at the landscape unit level. District staff note that in operational practice, maximum disturbance constraints are applied to individual visual landscape inventory polygons and they are not aggregated as in the analysis. They suspect that the timber supply analysis has slightly overestimated available timber supply on this account.

Sensitivity analysis was used to assess the potential timber supply impacts of modifying the assumptions to better approximate current practice. In the sensitivity analysis, the forest cover constraints were applied to visual landscape inventory polygons at the zone level to approximate the use of polygon-specific objectives. Results indicate that short-term timber supply is unaffected, but mid-term timber supply is reduced by 7 percent in decade 7. The long-term harvest level is also shown to be slightly lower (2.6 percent) than that projected in the base case.

I have reviewed the information about visually sensitive areas, and conclude as follows. I am mindful of the small adjustments required to green-up heights in each of the visually sensitive zones assumed in the analysis in order to more accurately reflect operational constraints, and will discuss this further under 'Reasons for decision.' With respect to the assumptions regarding maximum allowable disturbances in visually sensitive areas, I believe that the sensitivity analysis in which a medium VAC was applied and which used the midpoint of the ranges presents a better approximation of current practice, and provides me with an assessment of the risks posed to timber supply as a result of this factor. I will discuss this further under 'Reasons for decision.'

In addition, with respect to the aggregation of RVQC areas by landscape unit which was done in the analysis, I am satisfied from review of the information that this presented a slightly less constrained view of timber supply than current practices would indicate. Again, sensitivity analysis results provide insight into the influence of this factor. I will also take into account the risks posed to timber supply on this account, and will discuss this further in 'Reasons for decision.'

- recreation

The forests in the Arrow TSA are subject to significant recreational use given the proximity to provincial and national parks and the spectacular scenery of the area. The lakes, rivers and mountainous terrain of the TSA provide a wide range of front- and back-country recreational opportunities including mountain biking, hiking, fishing, camping, wildlife viewing, boating, heli-, cross-country and downhill skiing and snowmobiling.

ESA data was used in the timber supply analysis to exclude areas identified as either Er1 (highly sensitive) or Er2 (moderately sensitive) for recreation. District staff indicate that the

exclusions applied in the analysis appropriately reflect current management for recreational areas.

The Dewdney Trail is a heritage trail designated under the *Heritage Conservation Act* and the management specifications for the trail are described as a higher level plan under the Forest Practices Code. The trail corridor is defined as a 100 metre reserve zone to each side of the trail, and the timber within the trail corridor is not available for harvest unless salvage is required for disease, insect or fire management. The land base associated with the trail was entirely excluded from the timber harvesting land base in the analysis.

I have reviewed the information regarding recreation resources and am satisfied that there was an adequate accounting in the analysis for these values.

- cultural heritage resources

Under the *Forest Act*, a cultural heritage resource means 'an object, a site or the location of a traditional societal practice that is of historical, cultural or archaeological significance to British Columbia, a community or an aboriginal community.' Archaeological sites contain physical evidence of past human activity, whereas traditional use sites may not necessarily contain historical physical evidence but may indicate current use by a First Nation. As a first step in the management and conservation of archaeological resources in the Arrow Forest District, an archaeological overview assessment (AOA) was completed in 1996.

Archaeological potential, as outlined through the AOA, has been used to identify areas for archaeological sites within the timber harvesting land base that may require additional investigation in the form of an Archaeological Impact Assessment (AIA).

Between 1996 and 1999, over 90 areas were assessed within the TSA, leading to the description of one new archaeological site. This small site was avoided and buffered from any harvesting activity by locating it within a wildlife tree patch. The management for known archaeological sites has thus far resulted in a negligible impact on the timber harvesting land base, and as a result there were no explicit reductions applied in the timber supply analysis.

Traditional use sites may exist in the Arrow TSA. Two traditional use surveys have been conducted by First Nations but the information has not yet been provided to district staff. Staff indicate that traditional use sites have not impacted operations to date, but that they may have future impacts on operations.

Public input from the Slocan Valley Watershed Alliance and the Valhalla Wilderness Society expressed the opinion that sites should be mapped, assigned a buffer zone and modelled in the analysis. District staff note that AIAs are conducted where appropriate, and any located archaeological sites are managed for at the operational level.

In consideration of the information regarding cultural heritage resources, I am satisfied that no risk is posed to the archaeological resource as a result of the analysis assumptions, and that no explicit adjustment is required to account for this factor in this determination. These areas are being managed for appropriately at the operational level. If ongoing management for cultural heritage resources begins to impact operations, then it can be accounted for in a future determination.

- wildlife habitat

The Arrow TSA supports an abundance and wide variety of wildlife species, including more than 60 species of birds and many of the ungulate species which occur in British Columbia. Rocky mountain bighorn sheep, white-tailed and mule deer, moose, mountain goat, elk,

caribou, cougar, grizzly bear, wolf, black bear, bobcat, lynx, coyote, fisher marten, marmot and wolverine are among the species found in the TSA.

The Conservation Data Centre of BC maintains forest district tracking lists, which name those species and plant associations which are known to occur, strongly expected to occur, or which have occurred in the past within a given forest district, and which are considered vulnerable, rare or endangered. The Identified Wildlife Management Strategy (IWMS) addresses site specific habitat management for certain of these at risk species, as described in the next section.

1) identified wildlife

'Identified wildlife' refers to species at risk (red- and blue-listed) and to regionally significant species which are potentially affected by forest management activities and which have not been adequately accounted for with existing management strategies, such as those for biodiversity, riparian management, ungulate winter range or through the application of other forest cover constraints. Species at risk as defined under the Forest Practices Code also includes those species that are not considered at risk provincially but which have regional populations that may be threatened. The intent is that by addressing the habitat needs of 'regionally important wildlife' early on, the possibility that they will become listed provincially as threatened or endangered at a later date may be avoided.

Volume I of the IWMS was released in February 1999 and details several species which may occur and which require future consideration in the TSA, including the following: bull trout, rubber boa, American bittern, northern goshawk, prairie falcon, Lewis's woodpecker, bobolink, fisher, grizzly bear, mountain goat, and bighorn sheep. Volume II, which has yet to be released, may identify additional species. The species identified in Volume I will be managed through the establishment of wildlife habitat areas (WHAs) and implementation of general wildlife measures (GWMs), or through other management practices specified in higher level plans. Specific WHAs and GWMs for identified wildlife species have not yet been established in the Arrow TSA.

Based on data accumulated on the habitat requirements for the identified species, the estimated impact of management was projected at one percent of the short-term harvest level for the province. Government has committed to limiting the impact of management for identified wildlife to this level in the short-term.

The IWMS describes interim measures which may be taken for specific WHAs, in order to minimize the effects of forest or range practices on critical habitat attributes, such as nest sites and an adjacent area, pending approval of the area as a WHA. In the Arrow TSA, MELP staff have identified and mapped reserve areas around three goshawk nests and one great blue heron nest, which are consistent with the interim measures outlined in the IWMS. Operationally, any additional nest sites which are identified are reserved in wildlife tree patches. In the timber supply analysis, a small land base reduction of 42 hectares was applied to account for existing nest site reserves.

For this determination, it is not possible to specify the exact location or precise amount of additional habitat area that will be required within the timber harvesting land base to implement the IWMS. However, given the Province's commitment both to implement the IWMS, and to limit short-term timber supply impacts to one-percent province wide, as well as the expected occurrence of identified wildlife in this TSA, it is appropriate to account for an impact on timber supply.

The timber supply reduction is expected to be less than or equal to one percent, although at this time the exact impact is uncertain. Although no specific sensitivity analyses were conducted to evaluate the impact of this reduction, other results, such as those assessing the impact of uncertainties in the size of the timber harvesting land base, indicate that there is not likely to be any impact to short-term timber supply due to this factor alone. For this determination, I am mindful of the downward pressure and will take this into account under 'Reasons for decision.'

Public input expressed concern that an inventory is needed to implement the proposed reserve zones, and recommended an additional factor be applied in the analysis to account for nests not yet located. District staff respond that funding is not available to undertake an inventory of goshawk nests at this time, but that nests located during operational planning are managed for appropriately. They indicate that MELP, the licensees and BCFS staff co-operatively work to protect habitat for identified wildlife.

I encourage district and MELP staff work to establish WHAs and implement GWMs prior to the next determination for the Arrow TSA. The establishment of these areas is a significant protective measure of the Forest Practices Code, and it is important to formally establish them in order to assist with long-term planning and reduce operational conflicts between wildlife and harvesting.

2) ungulate winter range

The KBLUP contains provisions for the management of ungulate winter range, which occurs in various lower elevation areas throughout the TSA. Approximately 38 000 hectares of Crown forest land, which includes 19 000 hectares of timber harvesting land base is recognized as ungulate winter range in the Arrow TSA.

Consistent with the intent of the KBLUP, the ungulate winter range (which includes habitat for white-tailed deer, mule deer, moose and elk) for the Arrow TSA was mapped by district and MELP staff in 1998. This ungulate winter range has been designated under the *Forest Practices Code 1998 Operation Planning Regulation (OPR)* provisions for identifying and approving existing ungulate winter ranges through a process known as grandparenting.

In the timber supply analysis, forest cover constraints were applied to the operable land base within the designated winter range area to account for ungulate requirements. A maximum of 25 percent of the operable area could be covered with stands less than 2 metres in height (based on inventory top height), and a minimum of 40 percent of the area was required to be covered in trees at least 100 years of age.

As also discussed under *cutblock adjacency/green-up*, district staff indicate that a green-up height which more accurately reflects the intent of the KBLUP for ungulate winter range areas as well as constraints applied in current practice is 2.5 metres. District staff indicate that if the top height discrepancy is accounted for, based on 2.5 metres versus 2.0 metres, then the constraints would reflect current practice, given that the size of the area modelled for ungulate range was appropriate. From review of the information and discussions with district staff, I am satisfied that what was modelled in the analysis, in addition to the adjustment to green-up heights for which I am accounting in this determination, is an appropriate reflection of the operational constraints required to manage the resource value. I will discuss this further under 'Reasons for decision.'

3) grizzly bear habitat

Grizzly bear is a wildlife species present in the Arrow TSA. Although identified as a species under the IWMS, the management requirements for grizzly bear are generally accounted for separately and apart from the IWMS implementation.

The 1995 KBLUP contained recommendations for the management of grizzly bear habitat. These provisions are adhered to in current practice for the approval of operational plans. The provisions include management of habitat adjacent to avalanche tracks and management of access and road densities in critical drainages.

No specific constraints were applied in the timber supply analysis to account for grizzly bear habitat.

The Kootenay-Boundary Higher Level Plan Order also contains direction regarding grizzly bear habitat. However, staff do not anticipate timber supply impacts additional to those associated with the assignment of biodiversity emphasis options through the landscape unit planning process, and the target retention levels for old and mature forest, to result from the management provisions specified in the higher level plan. MELP staff are also satisfied that the assumptions regarding grizzly bear habitat in the analysis are consistent with both the intent of the KBLUP and the direction resulting from the Kootenay-Boundary Higher Level Plan Order.

I have reviewed the information regarding grizzly bear habitat. As discussed under *landscape level biodiversity*, I am mindful that the analysis appropriately reflected the delineation of landscape unit boundaries and the assignment of biodiversity emphasis options, as well as retention targets for old and mature forest that are consistent with the KBLUP, the Kootenay-Boundary Higher Level Plan Order and current operational practice. As also discussed under *landscape level biodiversity*, draft Old Growth Management Areas (OGMAs) have been delineated in the Arrow TSA and in this determination, I am assessing the risks posed to timber supply from the future establishment of these areas, as discussed under 'Reasons for decision.' As a result, I am satisfied that the analysis addressed the considerations for grizzly bear habitat appropriately, and make no adjustments in this regard.

4) caribou habitat

Caribou habitat in the Arrow TSA was mapped in 1998 following the intent of the KBLUP. The habitat comprises 8800 hectares in the Engelmann Spruce Subalpine Fir (ESSF) biogeoclimatic zone and 17 200 hectares in the Interior Cedar Hemlock (ICH) biogeoclimatic zone in the Arrow TSA. The timber harvesting land base constrained by management requirements for caribou habitat totals 16 000 hectares.

To account for management requirements, specific forest cover constraints were applied to the habitat areas in the two biogeoclimatic zones in the analysis. A maximum of 25 percent of the operable area with less than 80 percent slope could be covered with stands less than two metres in height in both zones. In addition, a minimum of 37 percent of the area in the ESSF zone, and 40 percent in the ICH zone, was required to be covered in stands at least 140 years of age. District and MELP staff reviewed the constraints applied in the analysis and indicate that they appropriately reflect current practice.

As discussed previously in this document, green-up heights which guide current operational practices in caribou management areas are 2.5 metres, rather than the 2 metres assumed in the analysis.

The Kootenay-Boundary Higher Level Plan Order contains direction for caribou habitat requirements which differ slightly from those reflected in the analysis. However, the slight differences are not expected to significantly impact timber supply. In consideration of the information, I am satisfied that the risk posed to timber supply on this account is small and I will make no adjustments for this determination. As more information becomes available and as the specific forest cover constraints in the Higher Level Plan Order begin to guide current practice, it can be further reflected in future determinations.

However, I will take into account the timber supply impacts resulting from adjusting green-up heights to 2.5 metres, and will discuss this further under 'Reasons for decision.'

- riparian habitat

Riparian habitats occur along streams and around lakes and wetlands. The Forest Practices Code requires the establishment of riparian reserve zones (RRZs) that exclude timber harvesting, and riparian management zones (RMZs) that restrict timber harvesting, in order to protect riparian and aquatic habitats. For a stream, lake or wetland, the RMZ and RRZ make up the entire riparian management area. For streams, stream classes (e.g., S1) described in the *Riparian Management Area Guidebook* are determined based on presence of fish, occurrence in a community watershed and average channel width criteria. The stream class is used to estimate the area required to be retained in the RRZ and the area or volume required to be retained in the RMZ. Similar criteria are used to classify and estimate RRZ and RMZ retention rates for lakes and wetlands.

In the Arrow TSA, in addition to the considerations for riparian habitat under the Forest Practices Code, specific high value fish-bearing streams requiring special protection measures were identified as a result of the implementation of the KBLUP. In 1998, MELP staff identified the ten most important fish-bearing streams and rivers in the district, and developed specific management criteria for operations in these regionally significant areas.

Constraints were applied in the analysis to reflect management considerations for riparian habitat in general as well as for the special fish-bearing stream watersheds.

To account for general management practices, information from a strategic level stream, wetland and lake classification completed by a consultant in 1997 for the Arrow Forest District was used. In total, 17 458 hectares of Crown forested land were identified, resulting in a total exclusion of 8975 hectares for RMZ and RRZ management following the accounting for other reductions.

District staff indicate that they were not satisfied with the classification as it did not include the S4 and S6 streams. To address the data gap, district staff recently completed a Geographic Information Systems (GIS) analysis which indicated an additional 3000 kilometres of streams had not been accounted for in the analysis. Approximately half of these streams in the timber harvesting land base are located in areas of less than 20 to 30 percent slope, indicating they are likely S4 and therefore implied to be fish-bearing. The remaining are on steeper slopes and are suspected to be S6 streams. District staff applied a methodology to estimate the RRZ and RMZ retention rates for the stream classes, and recommend an additional exclusion of 1373 hectares to account for S4 and S6 streams. Staff believe that this additional reduction in

combination with the reductions already included in the analysis for S1 to S3 and S5 streams, should adequately account for general riparian management.

Staff note, however, that the additional reduction to account for RRZs and RMZs on S4 and S6 streams reflects best and desirable management practices for these areas. Both BCFS and MELP staff indicate that in many cases, the historical harvesting practices for RMZs have not included retention of any basal area. BCFS staff state that this is expected to change in the future, as operational approvals now require some basal area retention in the RMZs on S4 and S6 streams.

As mentioned above, the identified regionally significant watersheds were also accounted for in the analysis. The associated watersheds were grouped into a specific regionally significant fish stream zone in the analysis, and a forest cover constraint was applied to approximate the management considerations. On the Crown land base, a maximum of 25 percent of the stands were permitted to be below 6 metres in height at one time.

A forest licensee expressed concern about the use of the regionally significant fish stream zone. District staff indicate that the information is considered during operational plan approvals for cutblocks which could potentially impact on the streams. Additional input from licensees expressed concern at the high exclusion applied in the analysis to account for riparian areas. District staff respond that in their view, given the riparian resources present in the TSA, more area should have been excluded to provide a full accounting, as described above.

The implementation of the objectives in the Kootenay-Boundary Higher Level Plan Order will result in additional requirements within community and domestic watersheds for class 4 streams. However, district staff indicate that it is not yet clear that these requirements will result in greater constraints to timber supply above those accounted for in this determination. Possible impacts of the additional requirements can be assessed through reviewing the sensitivity analysis in which the timber harvesting land base was reduced in size by a further 10 percent. The results of this sensitivity analysis showed timber supply was unaffected as compared to the base case until decade 3, when it declined to mid- and long-term levels approximately 10 percent below those of the base case.

From review of the information, I believe that any additional requirements for class 4 streams resulting from the Kootenay-Boundary Higher Level Plan Order are more likely in the range of less than one percent reduction in size of the timber harvesting land base, rather than the 10 percent examined by the sensitivity analysis. In any event, the sensitivity analysis showed no impact to short-term timber supply. Once the management direction for these streams becomes clear through the implementation of the Higher Level Plan Order, the specific requirements can be factored into future analyses.

I have reviewed the information regarding riparian habitat and I do accept that it is appropriate to take into account the exclusion of an additional 1373 hectares, which I will discuss further under 'Reasons for decision.'

With regard to the analysis assumptions around RMZs—whereby some retention of basal area in RMZ areas was assumed, although in current practice these areas are frequently clearcut—I note that greater retention in RMZ areas is consistent with the expected direction to be taken in the TSA. In particular, the Higher Level Plan Order contains direction for consumptive-use streams which will require greater retention in RMZ areas than applied historically, and these requirements will potentially guide operations for streams on about 47 percent of the timber harvesting land base within the TSA.

On these accounts, I believe that the analysis assumptions and the additional accounting for 1373 hectares of RRZ and RMZ areas as described above, should adequately account for constraints to timber supply to reflect the trends expected to arise until more experience is gained through implementation of the higher level plan.

- *community watersheds*

The Forest Practices Code provides a definition and management considerations for community watersheds. There are abundant water resources in the Arrow TSA.

Approximately 47 percent of the timber harvesting land base is contained in community and domestic watersheds.

A community watershed is defined under the Forest Practices Code as the drainage area that provides water for human consumption and that is licensed under the *Water Act* for a waterworks purpose or a domestic purpose, assuming the drainage area is not more than 500 square kilometres and the water licence was issued before June 15, 1995. This definition accounts for the majority of community watersheds in existence when the Forest Practices Code came into effect. Community watersheds not covered under this definition can be designated as such by the appropriate regional manager and a designated environmental official. Domestic watersheds are those consumptive-use watersheds described under the KBLUP implementation strategy, and are either class 1, 2 or 3. Each class is subject to different management constraints.

In operational practice, watershed assessment procedures (WAPs) are conducted by hydrologists in community and domestic watershed areas to determine whether planned operations can be conducted without detriment to water quality resources. A WAP considers the cumulative effects of forest practices on the aquatic environment. The assessment of hydrological impacts includes an assessment of the potential for the following processes to occur as a result of planned operational practices: changes to peak streamflows; accelerated landslide activity; accelerated surface erosion; channel bank erosion; and, changes to channel morphology. An evaluation of the interaction of these processes provides an indication of the sensitivity of the watershed to further forest development. Using the results of a WAP, forest managers can make recommendations concerning the level of further harvesting in the watershed.

A key component of watershed management includes calculation of equivalent clearcut area (ECA), which is the area that has been harvested, cleared or burned, with consideration given to the silvicultural system, regeneration growth and location within the watershed.

In the timber supply analysis, watershed areas in the TSA were grouped into three zones according to their classification: class 1 domestic watersheds; community and class 2 domestic watersheds; and class 3 domestic watersheds. Community watersheds and class 2 domestic watersheds were subjected to the same forest cover constraints because management requirements are often similar. Each zone had a specific forest cover constraint applied to approximate the constraints applied in current practice to control hydrological recovery rates. The forest cover constraints represent an approximate average of the maximum disturbance values suggested by the *Community Watershed Guidebook* and interior watershed assessment procedures, and reflect the intent of the KBLUP.

Although the analysis report indicated that the forest cover constraint was applied to the Crown forested area, in reality it was applied to the Crown land area within the zone. The maximum proportion of area permitted to be less than 6 metres in height in each zone was as follows:

- 15 percent of the area in class 1 domestic watersheds;
- 20 percent of the area in class 2 domestic watersheds and in community watersheds; and
- 25 percent of the area in class 3 domestic watersheds.

District staff note that considerations for approval of operations in watersheds include the condition of private land area and other factors which in operational practice are measured through the completion of watershed assessments. The results of a watershed assessment dictate the extent to which additional harvesting may occur in the watershed. District staff believe there is still some uncertainty as to whether the analysis assumptions completely reflect the management constraints in watersheds.

Public input was received regarding the modelling of requirements in community and domestic watersheds. The Valhalla Wilderness Society expressed several concerns, and suggested that the following considerations be included: the condition of private land within the watershed; accounting for the impact of logging upslope of unstable areas; and an increased green-up height of 12 metres based on data from recent studies. The Slocan Valley Watershed Alliance also expressed the opinion that the modelling of ECAs only was insufficient to reflect true management constraints for the watershed areas. Input from the Interior Lumber Manufacturer's Association (ILMA) questioned how the data compiled under the *Watershed Assessment Procedures*, which are used to guide operations in the community and domestic watersheds, was used in the analysis.

In response, BCFS branch and regional hydrology staff have further reviewed the constraints applied in the analysis and state that the modelling assumptions are consistent with existing knowledge and provincial policy, including the guidance contained in the *Community Watershed Guidebook*. The analysis assumptions were derived using information from watershed assessments, the *Community Watershed Guidebook*, and the *Interior Watershed Assessment Procedure Guidebook*. The regional hydrologist and the timber supply analyst worked to derive a set of assumptions which were believed to best reflect current and required management to protect the value of the resource. Data from watershed assessments were used in the derivation of the forest cover constraints. The 6 metre height used in the analysis reflects a 50 percent greened-up condition, and is believed to be appropriate given current knowledge about watershed dynamics and hydrological recovery rates. BCFS staff indicate that while some uncertainty still exists around how operational practices in watersheds can best be incorporated into timber supply analysis, the assumptions applied in the analysis represent a good approximation of management considerations. As more information becomes available to assist with extrapolating practice constraints into rates of cut, it can be factored into future analyses.

I have reviewed the information regarding the assumptions for community and domestic watersheds. I am mindful of the difficulties involved with incorporating operational considerations for management in watersheds into timber supply analysis, and believe that the constraints applied in the Arrow analysis—which were derived from careful background analysis and documentation—are reasonable. I am satisfied that management considerations for community and domestic watersheds have been appropriately reflected in the analysis.

I commend BCFS staff on their efforts to extrapolate the complex management requirements for water quality in community and domestic watersheds to constraints which can be used in timber supply analysis. I expect that as more information becomes available on management for water quality in watersheds, it can be incorporated into future analyses and determinations.

- *botanical forest products*

Botanical forest products are defined under the Forest Practices Code as any prescribed plant or fungus that occurs naturally on Crown forest land. In parts of the province, botanical forest products such as mushrooms or forest vegetation are harvested from Crown forest land.

In the Arrow TSA, harvesting of botanical forest products on Crown land does not occur on a large scale. Some mushroom harvesting occurs at the local level and can be considered an important local activity, particularly in the northern part of the TSA. However, no specific management constraints are applied operationally at this time. As a result, no specific criteria were applied in the timber supply analysis.

I have reviewed the information regarding botanical forest products and have discussed the information with district staff. I am satisfied for this determination that no specific accounting is required. I note, however, that on a provincial basis the issue of botanical forest products is being further examined, as there are forest management implications in some areas of the province. If better information becomes available over time, and if this use of Crown forest land becomes more prevalent in the Arrow TSA, then it can be reflected in future analyses.

- *stand level biodiversity*

Biodiversity is defined as the full range of living organisms, in all their forms and levels of organization, and includes the diversity of genes, species and ecosystems and the evolutionary and functional processes that link them. Under the Forest Practices Code, biodiversity in a given management unit is assessed and managed at both the stand and landscape levels.

Stand-level biodiversity management includes retaining wildlife tree patches (WTPs), within or adjacent to cutblocks to provide structural diversity and wildlife habitat. Where landscape unit planning has been completed and objectives have been set, table A3.1 in the *Landscape Unit Planning Guide* recommends retention rates for WTPs. For the Arrow TSA, landscape unit boundaries and biodiversity emphasis options were formally designated by the district manager and approved by the designated environmental official in April 1998, and therefore table A3.1 of the Guide was used in the timber supply analysis.

For the analysis, district staff followed procedures in the Guide to determine that the wildlife tree patch requirement for the analysis was 3.5 percent of the timber harvesting land base, which was applied as a reduction in the analysis, for a total removal of 7343 hectares.

At the time of the previous determination, I instructed district staff to 'quantify the volume of timber that is made unavailable for harvesting in order to account for stand level biodiversity.' To address this, district staff reviewed silviculture prescription data for cutting permits approved between June 1998 and June 2000. Data from the review suggests that 16 percent of the timber harvesting land base associated with the openings was retained in wildlife tree patches during that period. If this data was assumed to actually apply to the entire timber harvesting land base, and if the values summarized were independent of other factors, significantly more of the timber harvesting land base than assumed in the analysis is constrained by management requirements for stand-level biodiversity.

However, staff indicate that some of these areas are steep gullies or difficult access areas which may not have been harvested in any event, and which may be excluded from the land base in the analysis for other reasons. Staff also note that some of these areas identified as WTPs were flagged as planned for harvest in the future and hence do not represent long-term exclusions. Further, provincial policy recently clarified that areas designated as WTPs are to be retained

for at least one rotation, which staff expect may lead to decreased levels of retention in the future. Finally, it is noted that the WTP requirements indicated in some of the existing silvicultural prescriptions are likely intended to provide for stand-level biodiversity needs in adjacent unharvested areas, and this would result in a lesser impact to the timber harvesting land base than that suggested by the review.

I have considered the information, and I believe that the assumptions applied in the analysis were consistent with provincial policy direction intended to ensure adequate management protection for stand level biodiversity. Furthermore, I am not convinced that the operational assessment results definitively reflect current practice for several reasons.

The district review of operational data implies that retention of larger percentages of contributing area in WTPs maybe occurring within current practices. However, because this review covers only a two-year period, I am not convinced that the indications provide adequate validation of current and future practice. I recommend ongoing monitoring by district staff to assess the trends for retention over a greater time period.

Prior to the next determination, I also request that district staff clarify the relationship between the additional area retained as WTPs, and areas considered unavailable for harvest under other reductions applied in the analysis or through accounting made in this determination.

In addition, I request that licensees consider the implications of retaining larger percentages of timber harvesting land base for stand-level biodiversity than recommended in the *Landscape Unit Planning Guide*. The level of retention recommended in the Guide is considered appropriate to provide for stand level biodiversity needs.

In summary, I am not convinced that the review results can be extrapolated to the entire timber harvesting land base, or that they can be assumed to be applicable over a long time frame. However, I am concerned about the implications for timber supply if a higher level of retention continues over time. If ongoing monitoring and assessment verifies a higher level of retention is being practiced on the timber harvesting land base than recommended in the *Landscape Unit Planning Guide*, then I note it may be necessary to take greater reductions into account at the next determination.

This observation is not limited to the Arrow TSA, and I note that it highlights the need for clear tracking and monitoring mechanisms for WTPs within management units on a provincial scale. I have requested that Forest Practices Branch staff attempt to resolve this so that available timber supply can be more accurately projected for future analyses.

For this determination, I accept that stand-level biodiversity has been accounted for in the analysis consistent with provincial policy, and will make no further adjustments in this regard.

- landscape-level biodiversity

Achieving landscape-level biodiversity objectives involves maintaining forests with a variety of patch sizes, seral stages, and forest stand attributes and structures, across a variety of ecosystems and landscapes. Managing for biodiversity is based in part on the principle that this—together with other provisions in the Forest Practices Code, such as riparian management, maintenance of wildlife trees, and other forest cover objectives as discussed throughout this document—will provide for the habitat needs of most forest and range organisms. A major consideration in managing for biodiversity at the landscape level is leaving sufficient and reasonably located patches of old-growth forests for species dependent on, or strongly associated with, old-growth forests.

The delineation and formal designation of 'landscape units' is a key component of a sub-regional biodiversity management strategy. As mentioned under *stand level biodiversity*, landscape unit boundaries and assigned BEOs were delineated and formally designated by the district manager and approved by the designated environmental official in April 1998. As a result, the boundaries and BEOs were available for use in the timber supply analysis.

In accounting for landscape level biodiversity in the analysis for the Arrow TSA, a number of modelling assumptions were made which are discussed below.

1) seral stage requirements

Provincial policy direction for achieving landscape level biodiversity requirements is provided in the *Landscape Unit Planning Guide*, as well as in the established Kootenay-Boundary Higher Level Plan Order.

The 1995 KBLUP provided recommended target requirements for old and mature seral forest, and these requirements are also reflected in the HLP. Current management for landscape level biodiversity in the Arrow TSA includes provision for the maintenance of mature forest as well as old-growth forest.

Requirements for both mature and old forest were modelled in the timber supply analysis. The forest cover requirements were applied at the biogeoclimatic variant level within each landscape unit as a minimum percentage of the productive forest land base which must be retained in stands which met the requirements for mature and old forest. Depending on the natural disturbance type and biogeoclimatic unit, the minimum area to be retained in mature plus old seral forest varied in the lower BEO areas between 14 and 19 percent, in the medium BEO areas between 23 and 36 percent, and in the higher BEO areas between 34 and 51 percent.

The Guide permits old forest requirements for areas with low BEOs to be met within three rotations. However, in accordance with the policy guidance which followed the KBLUP, the mature plus old requirements in the low emphasis areas in the Arrow TSA were required to be met immediately in the base case. This requirement is consistent with the Kootenay-Boundary Higher Level Plan Order. Review of the analysis results indicates that the immediate application of the mature plus old constraint in the lower BEO areas was not constraining to timber supply in the base case of the analysis.

Current provincial policy direction from the *Landscape Unit Planning Guide* requires old seral requirements to be met immediately in high and intermediate BEO areas. If it is not possible to immediately achieve targets in these areas, then Old Growth Management Areas (OGMAs) are designated in mature forested areas to recruit old growth forest.

Approximately 51 000 hectares of draft OGMA's have been delineated in the Arrow TSA, which encompass about 20 000 hectares or 10 percent of timber harvesting land base. The Kootenay-Boundary Higher Level Plan Order contains recommendations for formal establishment of these areas. In current practice, these areas are reserved from harvest. Sensitivity analysis was used to assess the timber supply impacts likely from the establishment of these areas as permanent reserves. The results indicate that the mid- and long-term harvest levels decrease beginning in decade seven by 9 percent as compared to the levels projected in the base case.

The Kootenay-Boundary Higher Level Plan Order also prioritizes the areas from which the mature plus old requirements are to be met in a different manner than dictated by provincial

policy in order to meet specific objectives. An assessment of the issue indicates no timber supply impacts resulting from this requirement over and above the accounting for the formal establishment of OGMAs.

I have considered the information regarding the draft OGMAs and I believe that the availability of information regarding the placement of these areas provides a better assessment of the available timber supply under management requirements for old growth, than does the approximation provided by the application of generalized percentages to the land base. As a result, I will take into account in this determination the exclusion of these areas from the timber harvesting land base, as discussed in 'Reasons for decision.'

As mentioned earlier in this rationale, the KBLUP included direction to manage for patch size distribution, which was approximated in the analysis along with some accounting for connectivity through the application of an additional forest cover constraint. I believe that connectivity considerations are further approximated through the delineation of the OGMAs, which I discuss further in 'Reasons for decision.' With respect to patch size, I note that the analysis results which indicate timber supply is not constrained by this additional requirement are consistent with research results elsewhere, and I am satisfied that there is no need to account further for this factor.

With regard to both old and mature seral requirements, I am satisfied that the application of the mature seral requirement in the analysis is consistent with the intent of the KBLUP as well as the Kootenay-Boundary Higher Level Plan Order.

2) future ages of non-contributing forests:

In the timber supply analysis, forests outside the timber harvesting land base were assumed to continue to age over time such that eventually all non-contributing forests were over 250 years of age. This assumption means that no allowance was made for the possible influences that natural stand disturbances such as fire, insects or disease may have over time. In terms of landscape level biodiversity, the implication is that a larger proportion of the old seral requirements are met over time by non-contributing forests in the modelling than may be realized operationally.

Input was received from the Valhalla Wilderness Society which questioned the validity of this assumption, given the limited capability to fight wildfires in remote areas and the lower likelihood of salvage. District and Timber Supply Branch staff agree that eternal ageing of the non-contributing forest is not reflective of expected stand dynamics.

An alternative approach would be to assume that the existing age-class distribution in non-contributing stands remains the same over time (i.e. that disturbances will offset the ageing of the forests). However, this 'static' approach may lead to an overestimation in the number of natural disturbances, assuming that current fire suppression will enable a higher proportion of non-contributing forested areas to age undisturbed over time than in the past. This in turn would likely lead to an underestimation in the future contribution to old seral requirements made by currently young stands, as these age.

A sensitivity analysis was conducted in which the inoperable forest was assumed to be 'harvested' at a rate of 500 hectares per year, to provide some approximation of possible natural disturbance cycles. The sensitivity analysis results indicate that short-term timber supply is not impacted, but projected mid-and long-term harvest levels would decrease by approximately 50 000 cubic metres per year as compared to the base case.

Clearly, non-contributing forests do experience stand-level disturbances, and as a result the contribution of these forests to meeting old-seral biodiversity objectives has likely been overestimated in the analysis. It is likely that the base case and the sensitivity analysis projections represent the upper and lower bounds of the timber supply with respect to this factor. The actual stand dynamic which will occur is likely somewhere between these two extremes. On this basis, in my determination I accept an unquantified overestimation in the mid to long-term timber supplies projected in the base case, and will discuss this further in my 'Reasons for decision.'

- (vi) any other information that, in the chief forester's opinion, relates to the capability of the area to produce timber,

Other information

- Kootenay-Boundary Higher Level Plan Order

Strategic plans establish the broader context for operational plans by providing objectives for managing forest resources in a given area. There are several types of planning processes which are described as strategic in relation to operational planning processes. Distinction must be made between higher level plans as defined by the Forest Practices Code and strategic land use planning processes such as regional or subregional planning (land and resource management planning). Portions of plans arising from strategic planning processes may be declared as higher level plans under the Forest Practices Code. A higher level plan defined under the Forest Practices Code establishes government's social, economic and environmental objectives, thereby setting the resource management context for developing subsequent operational plans.

For the West Kootenay area, the Kootenay Boundary Land Use Plan (KBLUP) was completed and signed off by government in 1995. The Kootenay-Boundary Higher Level Plan Order, which contains critical components of the KBLUP, has recently been established by government.

The majority of the recommendations from the KBLUP, and contained within the Higher Level Plan Order, that are relevant to operations and timber supply have been implemented in the Arrow TSA and form part of current practice for operations in the area. As discussed previously in this document, the timber supply analysis assumptions for wildlife habitat, landscape level biodiversity, riparian habitat, watersheds, visual quality and other IRM objectives were consistent with the recommendations of the plan.

In 1997, a timber supply impact analysis was conducted which indicated the timber supply in the Arrow TSA could be affected by as much as 25 percent as a result of the implementation of the KBLUP recommendations. However, the 2000 timber supply analysis, which incorporated the impacts of implementation of the KBLUP in the analysis assumptions, indicates a much smaller timber supply impact. Review of the assumptions used in the two analyses indicate that some policy direction which was unclear at the time of the impact analysis has now been resolved, and this has acted to stabilize timber supply while still providing for the resource values.

The recently established Kootenay Boundary Higher Level Plan Order is not all inclusive, and there are some provisions which arose from implementation of the KBLUP which are not included in the Higher Level Plan Order, either because they are already satisfactorily

addressed by the Forest Practices Code (which was implemented after the 1995 KBLUP), because they do not affect operational or strategic planning and will be handled through other means, or because the provisions would result in unacceptable socio-economic impacts.

I am aware that current practice in the Arrow TSA is guided by the recommendations arising from the KBLUP, and these recommendations were used in the development of the assumptions for the 2000 timber supply analysis. I believe that the period following the establishment of the Kootenay-Boundary Higher Level Plan Order by government will provide greater clarity around the management for specific resource values in the Arrow TSA. If, during the period following the establishment of the Higher Level Plan Order, management considerations for specific values become less or more constraining than those which guided current practice between the KBLUP and the Higher Level Plan Order, then this can be factored into a future determination.

- Slocan Valley

The Slocan Valley extends along the shores of Slocan Lake and is entirely contained within the Arrow TSA. Over the past twenty years, there has been a series of local planning initiatives and conflicts around land and resource use in this valley.

Conflicts over land use have led to planning delays, logging deferrals and log-arounds for the timber harvesting activities in the TSA, the longer term effect of which is now an issue around the distribution of harvest. The conflicts and planning demands over the past twenty year period has resulted in an inability of licensees operating in the Slocan Valley to harvest their volume commitment.

As mentioned elsewhere in this rationale, to address concerns around land use in the south-eastern portion of the province, including the West Kootenay area which encompasses the Slocan Valley, government initiated a land use planning process early in the 1990's. The Kootenay Boundary Land Use Plan (KBLUP) was formally approved by government in 1995 and its recommendations have been implemented in the years that followed. The majority of the recommendations—as determined through the subsequent public planning processes to be critical—were recently established by government as a higher level plan. It is the understanding of government that the known concerns regarding land use for the West Kootenay area have been appropriately addressed through these land use planning processes and formally entrenched in the higher level plan. In addition to the land use planning processes, the Forest Practices Code provisions for riparian habitat, stand and landscape level biodiversity, visual quality and other resource values are also intended to be fully implemented in the Arrow TSA.

However, conflicts still exist around land use and timber harvesting activities in the Slocan Valley. In 1999, in an attempt to provide greater clarity for all concerned regarding land use in the Valley, the Arrow Forest District Manager presented government with several social economic options for land use in the Valley, including the option of designating the Slocan Valley under part 13 of the *Forest Act*. However, government chose to not provide special designation for the Slocan Valley. This information is an indication to me that government is not willing at this time to assign special status to the Slocan Valley nor to prohibit or restrict harvesting in this area.

As noted at the time of the previous determination for the Arrow TSA, the continued avoidance of harvesting in contentious areas places pressures on other portions of the land base in the TSA. In addition, as I also noted at that time, unless government specifically makes a land use

decision which prohibits or restricts harvesting in contentious areas, it is inappropriate for me under the *Forest Act* to consider these areas as not contributing to timber supply. To do otherwise is to assume a change in the overall land base of the TSA where no such change has actually occurred.

At the time of the previous determination for the TSA, it was hoped that the completion of the KBLUP and decisions regarding its implementation would resolve many of the issues surrounding land use in the Valley. However, despite the processes described above, and despite the operational implementation of the majority of the provisions of the KBLUP as well as the provisions of the Forest Practices Code, I am aware that some contention in the Valley still exists, despite the measures in both these instruments to provide for the resources in question.

I have considered the information regarding the Slocan Valley. No land-use decisions have been made for the Valley area that provide a rationale for removing the area from contributing to timber supply. As such, it is inappropriate for me to do anything other than to assume continued contributions from the Slocan Valley which are consistent with the resource values present in the area, and with the productive capacity of the land base. As discussed elsewhere in this document, the assumptions applied in the timber supply analysis incorporated the provisions of both the KBLUP and the Forest Practices Code. In order to clarify the timber supply contributions from the valley, in the analysis they were tracked separately. In the base case, an area delineated as the 'contentious area' associated with the Slocan Valley included portions of several landscape units and comprised approximately 14 percent of the timber harvesting land base. The base case analysis results indicated a contribution of 80 000 cubic metres per year from the delineated portion of the Slocan Valley was required in order to meet the base case harvest levels.

I am convinced that it is necessary to project the contribution of the Slocan Valley portion of the land base in the timber supply analysis. From discussions with district staff, however, I believe it to be more useful to define this portion of the land base by the boundaries of the landscape units encompassing it. The landscape units are the Hills, Idaho, Lemon, Pedro and Perry LUs, which comprise 34 259 hectares or 17 percent of the timber harvesting land base. Therefore, in the additional analysis described in the 'Reasons for decision', the Slocan Valley portion of the land base is so defined, and the harvest level contribution from this larger area is projected.

I will discuss my considerations of the Slocan Valley area further under 'Reasons for decision.'

- Innovative Forestry Practices Agreements

Under section 59.1 of the *Forest Act*, the Minister of Forests may enter into an Innovative Forestry Practices Agreement (IFPA) with the intent of improving the productivity of the forest resource. The Arrow Forest Licensee's Group, which is comprised of five major licensees operating in the Arrow TSA, was awarded the Arrow IFPA in July 1998. A forestry plan was subsequently submitted by the licensees and approved by the regional manager.

The projects under the IFPA are a collaborative effort between BCFS, MELP and licensee staff to attempt to mitigate the mid-term reductions projected in the timber supply analysis for the Arrow TSA. It is expected that the regional manager will be provided with an opportunity to evaluate the performance in June 2001.

I have reviewed the information regarding the IFPA and congratulate those involved for their efforts under this agreement. I am satisfied that there are no implications for this

determination. I look forward to any improvements in information which may result from the projects, and which may be relevant for a future timber supply review.

- operational plans

Licensees in the TSA annually prepare forest development plans (FDPs) which present a timber harvesting and forest development strategy for the upcoming five year period. In the Arrow TSA, the district manager has approved forest development plans for major licensees and the small business program which show locations for harvesting and road building for an average of the next three years.

District staff state that some licensees are having difficulties in identifying sufficient timber volume within their FDP operating areas while still respecting the recommendations for mature and old seral biodiversity targets which arose from the KBLUP. This has been exacerbated by log-arounds and deferrals on portions of the land base. Slocan Forest Products and the SBFEP have found the location of suitable harvest areas particularly challenging given the location of their chart areas in the Slocan Valley.

The timber supply analysis did not indicate any volume shortages in these chart areas in the short-term, and a review of the analysis results by BCFS staff confirmed that the volume should be available. However, district staff affirm that licensees are struggling to locate operations in their chart areas.

District staff believe that a twenty year plan prepared by licensees which provides improved information on harvest locations would possibly assist with future timber supply reviews. I concur with this assessment.

For this determination, I am mindful of the difficulties of locating harvesting operations in the Arrow TSA as a result of the various pressures exerted on the land base. This is particularly the case in the Slocan Valley portion of the land base where historically, social pressures have constrained operations, as discussed earlier under the *Slocan Valley*.

- harvest sequencing

In the base case of the timber supply analysis, it was assumed that harvest priority is placed on those stands which have aged furthest beyond their minimum harvestable age. For the purposes of modelling, this is expressed through the use of a *relative oldest first* harvest rule.

District staff express some uncertainty about whether this provides the best reflection of operational constraints. Staff note that different portions of the TSA are subject to varying management constraints which influence the choice of stands harvested. They believe that other criteria influencing the selection of stands for harvest may overshadow the option of choosing stands which are relatively the oldest in comparison to their minimum harvestable age.

Other possible harvest rules assume that the youngest stands relative to minimum harvestable age are selected first; that the absolute oldest stands are chosen first regardless of minimum harvestable age criteria; or that any stands older than minimum harvestable age might be randomly selected for harvest. Staff wonder whether current practice might be better reflected in the analysis by applying one of these other harvest rules, or alternatively by applying different harvest rules to different portions of the land base.

BCFS Timber Supply Branch staff acknowledge that the relative oldest first harvest rule may provide an upper bound to timber supply. However, they also note there is uncertainty around whether a purely random rule accurately reflects actual harvest planning and operations.

I believe that the use of the relative oldest first harvest rule may not entirely reflect operational constraints given the number and complexity of factors acting on the land base in the Arrow TSA, some of which were not entirely reflected in the analysis. I also believe it likely that a representative harvest rule is likely somewhere between a random harvest rule, and the relative oldest first applied in the analysis. BCFS staff recommend applying a modified harvest rule in which stands above 100 years of age are randomly selected for harvest, indicating that this provides a balance between the tendency to place priority on older stands, and accounting for the additional pressures influencing placement of operations.

Sensitivity analyses which evaluated the impact of applying random or absolute oldest first harvest rules indicated that the harvest level would be 7 or 4 percent less than that of the base case, respectively, after the seventh decade. These results provide an assessment of the risk posed to timber supply by uncertainties in harvest priorities. I have reviewed the information on harvest rules and believe that further monitoring and analysis will help to clarify this factor over time.

The sensitivity analysis indicates short-term timber supply is not affected and that the initial harvest level can be maintained regardless of uncertainties in this factor. The impact of a modified random harvest rule on timber supply will be less than that projected by the application of a purely random rule. However, I am mindful that both mid- and long-term timber supply is sensitive to harvest rules. In conclusion, I am aware of the potential risks posed to timber supply on account of this factor and will discuss this further under my 'Reasons for decision.'

I encourage district staff to monitor operational practice over the term of this determination, to obtain more quantified information regarding harvest rules for the Arrow TSA which might be useful for future analyses.

- First Nations considerations

The Ktunaxa-Kinbasket, Shuswap and Okanagan Nations have asserted traditional territories within the Arrow TSA. The Ktunaxa-Kinbasket Tribal Council, on behalf of the Ktunaxa Nation, has submitted to the provincial government a comprehensive land claim covering the south-east corner of the province, including part of the Arrow TSA. The Westbank First Nation, a member of the Okanagan Nation, has also entered into land claim negotiations for a portion of the Arrow TSA. The Shuswap Nation Tribal Council, though not participating in the formal treaty process, have stated their interest in taking part in some form of negotiation with the provincial government regarding their asserted traditional territory.

As discussed under my 'Guiding Principles', it is inappropriate for me to attempt to speculate on the impacts on timber supply that will result from decisions that have not yet been taken by government. As any decisions on treaty negotiations are undertaken by government, they will be reflected in future timber supply analyses for the TSA.

- (b) the short and long term implications to British Columbia of alternative rates of timber harvesting from the area,

Alternative rates of harvest

- harvest flow

The nature of the transition from harvesting old growth forests to harvesting second growth forests is a major consideration in determining AACs in many parts of the province. In the short-term, the presence of large timber volumes in older forests often permits harvesting above long-term levels without jeopardizing future timber supply. In keeping with the objectives of good forest stewardship, AACs in British Columbia have been and continue to be determined to ensure that current and medium-term harvest levels will be compatible with a smooth transition toward the usually (but not always) lower long-term harvest level. Thus, timber supply should remain sufficiently stable so that there will be no inordinately adverse impacts on current or future generations. To achieve this, the AAC determined must not be so high as to cause later disruptive shortfalls in supply nor so low as to cause immediate social and economic impacts that are not required to maintain forest productivity and future harvest stability.

In the analysis for the Arrow TSA, several alternative rates of harvest were evaluated in addition to the base case harvest forecast. One option, in which a non-declining harvest forecast was tested, illustrated that an initial harvest level which could be maintained over the analysis horizon was 511 280 cubic metres per year, or 16 percent lower than the current harvest level. The harvest remained at this level until decade nine when it rose to 544 000 cubic metres per year and then followed the same projection as the base case harvest forecast.

Another alternative tested the feasibility of maintaining the current AAC for as long as possible without causing timber supply shortages in the future. The results indicate that it is possible to maintain the current AAC for four decades before declining to the base case mid-term harvest level of 493 500 cubic metres per year. However, in this forecast, the mid-term timber supply remains at this lower level until decade 15, after which it follows the same projection as in the base case.

A final alternative tested the feasibility of lowering the harvest immediately by 10 percent to 548 370 cubic metres per year. It was possible to maintain this harvest level for three decades before following the same harvest projection as shown in the base case.

As discussed under Base Case for the Arrow TSA, I have reviewed the alternative harvest forecasts provided, and am satisfied that the harvest flow selected as the base case provides the most suitable forecast of timber supply of the forecasts prepared, and provides a suitable basis from which to evaluate the assumptions applied in the analysis.

- community dependence on the forest industry

The socio-economic analysis for the Arrow TSA details the impact of timber supply adjustments on local communities and the provincial economy.

These local communities include the cities of Castlegar, Rossland and Trail, as well as the villages of Warfield, Montrose, Fruitvale, Salmo, Slocan, Silvertown, New Denver and Nakusp. According to the 1996 census, the Arrow TSA supports a population of approximately 46 000.

The most significant contributors to the economy of the Arrow Forest District are the public sector (including government-employed forestry workers), the forestry sector, other primary industries such as mining, and tourism. Total employment in the forestry sector accounts for 19 percent of employment in the forest district.

Actual annual harvest levels in the Arrow TSA have been less than the AAC for the past few years. Between 1996 and 1998, the average annual harvest of approximately 550 000 cubic metres supported an estimated 1446 person-years of total annual employment province-wide, 626 person-years of which was direct employment in harvesting, silviculture and timber processing, and 820 person-years of which was indirect or induced employment.

If the current AAC of 609 300 cubic metres (excluding the woodlot licence volume) were fully harvested, it would support 1602 person-years of total employment province-wide, 935 person-years of which (direct, indirect and induced) would be in the TSA, and generate 62.9 million dollars per year in employment income. Annual provincial revenues associated with this AAC including provincial income tax, royalties, stumpage and rent total approximately 26.7 million dollars.

Following the base case harvest forecast, the socio-economic analysis indicates that the 10 percent reduction in decade two to 548 400 cubic metres per year would lead to a 10 percent reduction in both TSA and provincial employment, and corresponding reductions in both employment income and provincial revenues.

I have reviewed the socio-economic analysis that used an established and sound methodology to evaluate the community dependencies for the Arrow TSA. I am mindful that the communities within the Arrow TSA are dependent on the timber supply from the TSA, and that any reductions to timber supply will have an impact on these communities.

- difference between AAC and actual harvest

The following table describes the actual harvest levels in the Arrow TSA in recent years, for all apportioned programs except for the woodlot licence apportionment of 9700 cubic metres.

Type of Licence	cubic metres					
	1994	1995	1996	1997	1998	average 1994-1998
Forest Licence	431 967	456 444	447 427	341 207	398 058	415 021
SBFEP	51 794	46 494	105 617	68 802	125 147	79 571
Timber Sale Licence	1 148	7 700	5 501	0	0	2 870
Other	6 791	5 148	40 042	60 896	57 617	34 099
Total	491 700	515 786	598 587	470 905	580 822	531 561
% of AAC (Not including woodlot licences)	81	85	98	77	95	87

The AAC has not been entirely achieved in the Arrow TSA since 1989. However, the majority of the licensees have met both their annual and periodic cut control requirements. Slocan

Forest Products, whose operations in the TSA are largely within the Slocan Valley, has been unable to achieve its cut control. During the 1992 to 1996 cut control period, its actual harvest was only 68 percent of its commitment. Over the past three year period, the licensee has managed to harvest on average only 56 percent of its committed volume. By comparison, the average of all licensees in the TSA for the 1992 to 1996 cut control period was 77 percent and for the past three years has been 78, 98 and 85 percent respectively.

I have reviewed the information presented and am mindful of the pressures placed on operations by historical conflicts around land use and forest practices in the TSA, and most specifically in the Slocan Valley.

- (c) the nature, production capabilities and timber requirements of established and proposed timber processing facilities,

Timber processing facilities

- existing mills

Approximately 80 percent of the timber harvested in the TSA is processed within the TSA. Timber processing facilities within the TSA include: lumber mills, one pulp mill, several pole plants, shake and shingle mills and a veneer plant, and several secondary value added manufacturing facilities. The timber processing capacity within the TSA totals more than 2.2 million cubic metres per year.

The majority of timber harvested in the Arrow TSA is processed into lumber, veneer and wood chips. A small portion of the harvest is processed into other products such as shakes and shingles, poles, and posts at mills in the TSA and neighbouring TSAs. Wood chips are shipped to the Celgar Pulp Ltd. mill in Castlegar for processing into pulp. The mills in the TSA also process harvested timber from other TSAs, TFLs or private sources.

I have reviewed the information regarding timber processing facilities and conclude that there is a high level of demand from within and outside the TSA for the timber harvested.

- proposed facilities

Two new value-added mills are currently proposed in the Arrow TSA and the outlying vicinity. A major licensee has committed to build a value-added mill in an adjacent TSA, with an estimated start date of April 2001. The intended products are flooring, panelling and edge-glued commodities using birch, Douglas-fir and larch. Another facility is under construction within the TSA itself.

I have reviewed the information regarding proposed facilities and am aware of no issues which would impact this determination.

- (d) the economic and social objectives of the government, as expressed by the minister, for the area, for the general region and for British Columbia,

Economic and social objectives

- Minister's letter and memorandum

The Minister has expressed the economic and social objectives of the Crown for the province in two documents to the chief forester—a letter dated July 28, 1994, (attached as Appendix 3)

and a memorandum dated February 26, 1996, (attached as Appendix 4). The letter and memorandum include objectives for forest stewardship, a stable timber supply, and allowance of time for communities to adjust to harvest-level changes in a managed transition from old-growth to second-growth forests, so as to provide for community stability.

The Minister stated in his letter of July 28, 1994, that "any decreases in allowable cut at this time should be no larger than are necessary to avoid compromising long-run sustainability." He placed particular emphasis on the importance of long-term community stability and the continued availability of good forest jobs. To this end he asked that the chief forester consider the potential impacts on timber supply of commercial thinning and harvesting in previously uneconomical areas. To encourage this the Minister suggested consideration of partitioned AACs.

I have considered the contents of the letter and memorandum in my determination of an AAC for the Arrow TSA. I have reviewed the information about the applicability of commercial thinning in the TSA, and, as discussed under *incremental silviculture*, I conclude that there are limited opportunities for commercial thinning at this time. As the second growth stands in the TSA age, opportunities will likely increase and if so I will consider this further at a future determination.

With respect to harvesting in previously uneconomic areas, I have considered the assumptions applied in the analysis, and am satisfied that no additional opportunities are available beyond what was considered in the analysis at this time. However, as discussed extensively in 'Reasons for decision', I have considered establishing a partition for the Arrow TSA.

The Minister's memorandum addressed the effects of visual resource management on timber supply. In it, the Minister asked that pre-Code constraints applied to timber supply in order to meet VQOs be re-examined when determining AACs in order to ensure they do not unreasonably restrict timber supply. For the Arrow TSA, this consideration was handled through accounting for the 1995 KBLUP and current management direction as discussed under *visually sensitive areas*.

- local objectives

The Minister's letter of July 28, 1994, suggests that the chief forester should consider important social and economic objectives that may be derived from the public input in the timber supply review where these are consistent with government's broader objectives. There were many public responses received to the information report and data package, and to the timber supply and socio-economic analyses. The summary of public input is reproduced in full as Appendix 5.

The KBLUP, the intent of which forms current practice in the Arrow TSA and has been accounted for in this determination, was approved after years of public dialogue and negotiation. The Kootenay Boundary Higher Level Plan Order has recently been established by government. Establishment of the Higher Level Plan Order provides further clarification for some objectives as they continue to be interpreted and implemented. Some public input was received regarding the use of assumptions around the KBLUP. Given that the base case assumptions essentially reflected the direction in the KBLUP and the Higher Level Plan had not yet been declared, input for the most part tended to question the use of these assumptions and their constraint on timber supply. I note that, as the Higher Level Plan Order has only recently been established, I have largely taken guidance from the pre-existing approved KBLUP which guides current practice in the TSA. However, from review of the information

and as discussed in this rationale, I am satisfied that the analysis assumptions combined with additional accounting that I make in this determination reasonably reflect the intent of the Higher Level Plan. As experience is gained through implementing the HLP, there may be further as yet unforeseen adjustments to current practices and this will remove any residual uncertainty associated with the plan. If this occurs, the results of this experience can be taken into account in a future determination.

Public input received from the Slocan Valley Watershed Alliance and several other submissions made reference to the community objectives expressed for the Slocan Valley in a 1998 report entitled *Building a Healthy Valley Economy – A Community Action Plan*. The action plan was developed under the direction of a steering committee of local citizens with the goal of identifying natural resource based opportunities to build a stronger, more self-sufficient valley economy. Statements within the report include the following: that the current rate of timber harvest is too high and a major impediment to sustainable development in the valley, that there is a need to resolve current conflicts so that communities can have more certainty, that there is a need for ecosystem based planning, that tenure reform is necessary, including allocation of community forest tenures and greater community control, and that there is a need for more selective harvesting and labour intensive harvesting practices. I am mindful of the public input received and where possible in this rationale, I have attempted to respond briefly to specific concerns. Consideration of public input has been an important component of the determination for the Arrow TSA. I note that some of the public input received relates to items beyond my mandate for consideration under the *Forest Act*, which relates specifically to the determination of AACs for timber supply areas and tree farm licences.

Local objectives have been an important consideration in my determination of an AAC for the Arrow TSA.

- (e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area.

Abnormal infestations and salvage

- unsalvaged losses and salvage program

Unsalvaged losses are timber volumes destroyed or damaged by agents such as fire and disease that are not recovered through salvage operations. A number of parasites, fungi or plants can kill trees or degrade the quality and value of logs. Estimates for unsalvaged losses account for epidemic (abnormal) infestations on the timber harvesting land base that are not incorporated into yield estimates used in the analysis. Timber volume losses due to insects and diseases that normally affect existing stands (endemic losses) are generally accounted for in inventory sampling for existing timber yield estimation or through other methods. Losses associated with second-growth stands are addressed as noted under *operational adjustment factors*.

In the analysis for the Arrow TSA, a total of 28 720 cubic metres per year in unsalvaged losses was assumed at the start of the analysis horizon. Of this amount, 20 420 cubic metres were attributable to insects and disease, a further 5800 cubic metres to wildfire, and 2500 cubic metres to windthrow. At 100 years in the analysis horizon, the unsalvaged loss estimate was reduced to 23 000 cubic metres annually, to reflect an expected reduced impact from white pine blister rust. There were no reductions explicitly applied to account for additional losses resulting from armillaria, as it was anticipated that the decay, waste and breakage factors in

VDYP as well as the standard provincial OAF reductions applied in TIPSYS would account for armillaria losses.

District staff believe that the values applied in the analysis are reasonably reflective of current stand conditions. Staff expect to have a more comprehensive Geographic Information System (GIS) database for unsalvaged losses available for the next timber supply review.

As discussed under *operational adjustment factors*, it is possible that the influence of armillaria over time may also increase the unsalvaged losses in the TSA. However, some accounting for this was already made in the timber supply analysis. As better information becomes available over time on this issue, it can be incorporated into a future determination.

Public input expressed the opinion that unsalvaged loss estimates should include expected impacts of global warming and climate change on forests. While I agree that these climatic factors may influence stand growth, I note that any possible losses resulting from these factors are subject to much uncertainty and impossible to quantify at this time. I therefore make no adjustments in this regard.

Additional public input questioned the values used to estimate fire losses, which equate to loss of 20 hectares per year. To estimate fire losses, district staff compiled fire history values for the past 10, 20 and 30 years, resulting in estimates of 17, 13 and 61 hectares per year respectively. Staff noted that 30 years ago, burned areas were difficult to access and timber was not salvaged, which leads to the higher derived value for that timeframe. Staff believe the 20 hectare per year estimate to be a good reflection of expected losses given the current level of fire suppression in the TSA. I have reviewed the information and values and concur with the assessment of district staff.

For this determination, I accept that the figures used in the analysis constitute the best available information and adequately account for unsalvaged losses. I encourage district staff to continue to monitor trends such that any additional information can be incorporated into future timber supply analyses. In particular, I note that the inventory data indicates many of the stands in the Arrow TSA are approaching age and diameter thresholds which will make them more susceptible to attack from insects such as bark beetles. I request that district staff continue to monitor and track loss estimates carefully, so that future determinations can account for any greater losses which may result over time as a result of stand dynamics.

Reasons for Decision

In this determination, given the complexity and number of the factors affecting timber supply, I have grouped them according to whether they indicate timber supply may be higher or lower than projected in the base case.

There are a number of factors which indicate that timber supply as projected in the base case may be overestimated to some degree, as follows:

- 1) *economic and physical operability* – an up to 940 hectare overestimation in the size of the timber harvesting land base as a result of the inclusion of areas now considered to be inoperable;
- 2) *problem forest types* – an overestimation of 4616 hectares in the size of the timber harvesting land base resulting from the inclusion of decadent hemlock stands;
- 3) *woodlots* – an additional volume reduction of 2315 cubic metres per year is required to fully account for issued woodlots;

- 4) *operational adjustment factors* – an additional volume adjustment may be required to account for volume losses resulting from the presence of armillaria in managed stands; and as well an additional volume reduction of 10 percent should be applied to approximately 8400 hectares of high risk spruce stands to account for damage resulting from the leader weevil;
- 5) *cutblock adjacency/green-up, ungulate winter range and caribou habitat* – green-up heights in these three zones in the analysis were 0.5 metres lower than the heights applied in current practice, necessitating a small adjustment;
- 6) *visually sensitive areas* – the assumptions in the analysis were slightly less constraining to timber supply than operational practices, as a result of both different methodologies used in the aggregation of visual polygons, and the assumption that all areas are subject to a high rather than a medium visual absorption capacity;
- 7) *identified wildlife* – an additional exclusion of up to 2000 hectares or 1 percent of the timber harvesting land base, to account for management considerations for identified wildlife;
- 8) *riparian values* – an additional exclusion of 1373 hectares to account for management along S4 and S6 streams.
- 9) *harvest sequencing* – it is suspected that operational practices are likely reflected by a harvest prioritization for stands which falls in somewhere in the range between the relative oldest first harvest rule applied in the analysis, and a random harvest rule;
- 10) *OGMAs* – the placement of the draft OGMAs on the timber harvesting land base provides a better projection of old seral retention than the approximations applied in the analysis.
- 11) *future ages of non-contributing forests* – the assumption in the analysis that the non-contributing land base continues to age indefinitely is not reflective of expected stand dynamics, and likely overestimates the availability of old growth for harvesting on the timber harvesting land base;

In addition to the factors described above which indicate that timber supply is more constrained than projected in the base case, there are also a number of factors which indicate that the base case could underestimate timber supply, as follows:

- 1) *soil stability* – the use of an overly constraining methodology to derive exclusions for unstable soils results in an underestimation in the size of the timber harvesting land base of approximately 4300 hectares;
- 2) *site productivity* – it is likely that the potential site productivity of managed stands has been underestimated by the data in the inventory file. This does not impact short-term timber supply, but could impact mid to long-term timber supply in the range of 7 to 9 percent.
- 3) *class A seed* – given the increasing capacity of seed orchards, I consider it to be highly likely that there will be mid to long-term timber supply increases possible as a result of the use of class A seed in the Arrow TSA.
- 4) *visually sensitive areas* – the green-up heights applied in visually sensitive areas were slightly higher than those used in operational practice.

Often in the course of AAC determinations, I am able to assess the likely interactions between a variety of factors, such as those that work to either augment or restrict timber supply in relation to the base case projections, as noted above. However, from time to time, I have found

it necessary to request some additional analysis to help me understand the cumulative, dynamic interaction between a host of complex considerations such as those noted through the course of this review and determination. Accordingly, I requested additional analysis for the Arrow TSA, and first I will outline the various considerations by way of noting what influences were accounted for in this additional analysis. Secondly, I will refer to the results of this work by stating what it means to this determination.

The revised analysis accounts for the following modifications to assumptions, when compared to those assumptions applied in the base case:

- 1) a reduction in the size of the timber harvesting land base of 940 hectares to account for inoperable areas;
- 2) a reduction in the size of the timber harvesting land base of 4616 hectares to account for problem forest types;
- 3) an increase of 4300 hectares in the size of the timber harvesting land base, to account for the overly constraining methodology used to estimate unstable soil exclusions;
- 4) a 2315 cubic metre per year adjustment to account for the remainder of volume in issued woodlots;
- 5) the application of site index adjustments from OGSi paired plot studies to spruce and pine stands;
- 6) the application of genetic gain adjustments to all future regenerated stands, using the gain values calculated for available and expected seed orchard supply for the TSA;
- 7) the application of a 2000 hectare reduction (one percent) in the size of the timber harvesting land base to account for the expected impacts of management for identified wildlife;
- 8) the application of a 1373 hectare decrease in the size of the timber harvesting land base to account for riparian management for class 4 and 6 streams;
- 9) a reduction in the timber harvesting land base to account for the expected placement of the delineated draft OGMA areas, and removal of the old seral forest cover constraints which approximated these areas in the base case;
- 10) the application of a 2.5 metre height in the IRM, ungulate winter range and caribou zones, instead of the 2.0 metre height applied in the analysis;
- 11) the application of maximum allowable disturbance values at the zone level, the application of disturbance values to reflect medium visual absorption capacity and adjustments to green-up heights in visually sensitive areas to better approximate current management constraints;
- 12) the application of a modified random harvest rule in which harvest priority was randomly placed on any stands greater than 100 years of age, to reflect a harvest priority somewhere between the relative oldest first used in the analysis and a truly random rule;
- 13) the application of a minimum harvestable ages which reflect 95 percent of the culmination ages of stands;
- 14) 'harvesting' of the non-contributing land base at a rate of 500 hectares per year, to approximate expected natural disturbance regimes; and
- 15) tracking of the harvest contributions from the area comprising the Slocan Valley, and adjustment of the boundaries of this area to reflect the landscape unit boundaries encompassing the Valley.

The results of the additional analysis indicated the sensitivity of timber supply to the adjustments in these constraints, and provided me with an assessment of the risks to short-, mid- and long-term timber supply on account of these factors.

With the additional constraints described above applied, the initial harvest level of 609 300 cubic metres per year as projected in the base case could not be achieved. The initial harvest level possible with these constraints applied, and which did not result in unacceptable timber supply disruptions in the mid to long-term, is 550 000 cubic metres per year. This short-term harvest level can be maintained for only one decade, before declining in steps to mid- and long-term levels below those of the base case. The long-term harvest level projected in this forecast is 472 000 cubic metres per year.

This additional analysis accounted for all factors noted in this section, except for the influence of terminal weevil and the uncertainty associated with root diseases. At the time that I requested the additional work, it was not yet decided what would be the most appropriate way to consider these factors, and as a result they were not included. Subsequently, giving these matters further consideration, I have reasoned as follows. In the case of the impact expected from terminal weevil, I have discussed this matter with the analyst who conducted the additional combined review of factors, and I am advised that given only a 0.4 percent downward influence of this factor, and acting in the long-term, that it would not otherwise affect short- or medium-term timber supply even given the combination of additional constraints modelled in the additional analysis. Therefore, I would expect that this factor would only work to reduce the long-term timber supply projection shown in the combined run by an amount less than 0.4 percent, and I am accounting for it by stating that I expect long-term timber supply to be further restricted on account of this factor by an almost insignificant amount, especially when compared to the more dramatic influence of the many other factors assessed in the additional analysis as compared to the base case.

With respect to the uncertainty identified around the presence of root disease in the Arrow TSA and the expected impact on timber supply, I do believe that some reduction to volumes for managed stands is likely. However, given that it is not possible to quantify the volume impact expected, and further that the extent of the disease in the TSA is not well quantified, I cannot reasonably estimate a timber supply impact with any degree of certainty. Given that the impacts are on managed stands and therefore act in the mid to long-term only, and do not affect short term timber supplies, I am satisfied that there is no risk posed to this determination as a result of not being able to quantify this factor. Better information will hopefully provide clarity on this issue for the next determination.

There is one remaining consideration that has historically influenced operations in the Arrow TSA. I am mindful of, and concerned about the historic inability for operations in the Slocan Valley to be conducted at a level that reflects the productive capacity of the area. Harvesting and other operational activities in the valley have resulted in much controversy and very limited operations over the past two decades. However, I note that recent land-use processes (the KBLUP and the Kootenay-Boundary Higher Level Plan Order) were well informed by a broad range of public views on these and other matters. After considering the geographic distribution of a host of resource values and public interests government concluded that on balance, timber harvesting should occur in the valley in a manner which is consistent with other important goals and objectives of the plans.

I observe that the combination of the Forest Practices Code and land-use planning provisions has resulted in a complex but clear set of management objectives for the TSA. I am satisfied

from my review of the information that the analysis assumptions, combined with any adjustments I have made in this determination as described in the reasoning above and as incorporated into the additional analysis also discussed above, reflect the intention of the Kootenay-Boundary Higher Level Plan Order.

However, I remain mindful that the management objectives for the Slocan Valley area must be attained in order to avoid placing increasing harvest level pressures on other portions of the land base in the TSA. District staff have expressed the concern that operations must be fully distributed across the entire TSA land base in order to properly manage and conserve forest resources within the TSA and I share their concern.

However, I do not consider it to be appropriate or necessary at this time to partition the harvest level for Slocan Valley area in order to specify an amount of the total AAC that is expected from this area. The KBLUP has provided clear management direction for the whole TSA including historically contentious areas and it is my view that operations must now be distributed across the TSA in a manner that is consistent with the intent and objectives of the plan. Specifically, I observe that it is necessary for operations to be conducted in the Slocan Valley area at a level that approximates that assumed in this determination—which based on the additional analysis to support this decision—is 81 700 cubic metres per year.

In consideration of the items discussed above, I believe that a harvest level that incorporates the best available information and provides accounting for the risks posed to timber supply as a result of uncertainties, is 550 000 cubic metres per year. As discussed above, while this AAC is not being partitioned, I do expect performance in the Slocan Valley to be attained over the term of this determination at a level which approximates the annual harvest contribution assumed from that portion of the land base. This matter will obviously require thorough review at the time of the next determination.

Determination

I have considered and reviewed all the factors as documented above, including the risks and uncertainties of the information provided. It is my determination that a timber harvest level that accommodates objectives for all forest resources during the next five years, that reflects current management practices as well as the socio-economic objectives of the Crown, can be best achieved in the Arrow TSA by establishing an AAC of 550 000 cubic metres. This AAC excludes the volume issued to woodlot licences.

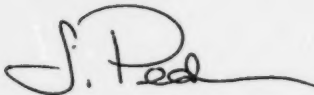
If additional significant new information is made available to me, or major changes occur in the management assumptions upon which I have predicated this decision, then I am prepared to revisit this determination sooner than the five years required by legislation.

Implementation

In the period following this decision and leading to the subsequent determination, I encourage BCFS staff to undertake the tasks and studies noted below that I have also mentioned in the appropriate sections of this rationale document. I recognize that the ability of staff to undertake these projects is dependent on available staff resource time and funding. These projects are, however, important to help reduce the risk and uncertainty associated with key factors that affect the timber supply in the Arrow TSA. I recommend that district staff:

- monitor harvesting performance in sites with low productivity, particularly in stands near the minimum site productivity threshold;

- refine the methodology for the exclusion of areas with sensitive or unstable soils;
- review the criteria used for problem forest types, and monitor performance in these stands;
- work with licensee staff to refine the methodology and percentage reductions for roads, trails and landings;
- pursue funding for a new forest inventory for the TSA;
- work with licensee staff to collect improved site productivity data for the stands in the TSA, including involvement as appropriate in the ongoing project under the IFPA;
- work with regional and branch staff to attempt to better quantify timber supply impacts as a result of armillaria infestation, as well as those expected from leader weevils;
- work with licensee staff to ensure operational management requirements for stand level biodiversity is consistent with provincial policy;
- attempt to better define the harvest rule or rules which best describe operational practices on the TSA land base;
- track harvest performance in relation to the targets set for volume contributions inside and outside the Slocan Valley in order to monitor performance through the term; and
- monitor stand impacts from bark beetle infestations and the ramifications of the associated volume losses in terms of non-recoverable losses.



Larry Pedersen
Chief Forester
January 24, 2001



Appendix 1: Section 8 of the *Forest Act*

Section 8 of the Forest Act, Revised Statutes of British Columbia 1996, reads as follows:

Allowable annual cut

8. (1) The chief forester must determine an allowable annual cut at least once every 5 years after the date of the last determination, for
 - (a) the Crown land in each timber supply area, excluding tree farm licence areas, community forest areas and woodlot licence areas, and
 - (b) each tree farm licence area.

- (2) If the minister

- (a) makes an order under section 7 (b) respecting a timber supply area, or
 - (b) amends or enters into a tree farm licence to accomplish the result set out under section 39 (1) (a) to (d),

the chief forester must make an allowable annual cut determination under subsection (1) for the timber supply area or tree farm licence area

- (c) within 5 years after the order under paragraph (a) or the amendment or entering into under paragraph (b), and
 - (d) after the determination under paragraph (c), at least once every 5 years after the date of the last determination.

- (3) If

- (a) the allowable annual cut for the tree farm licence area is reduced under section 9 (3), and
 - (b) the chief forester subsequently determines, under subsection (1) of this section, the allowable annual cut for the tree farm licence area,

the chief forester must determine an allowable annual cut at least once every 5 years from the date the allowable annual cut under subsection (1) of this section is effective under section 9 (6).

- (4) If the allowable annual cut for the tree farm licence area is reduced under section 9 (3), the chief forester is not required to make the determination under subsection (1) of this section at the times set out in subsection (1) or (2) (c) or (d), but must make that determination within one year after the chief forester determines that the holder is in compliance with section 9 (2).
- (5) In determining an allowable annual cut under subsection (1) the chief forester may specify portions of the allowable annual cut attributable to
 - (a) different types of timber and terrain in different parts of Crown land within a timber supply area or tree farm licence area, and
 - (b) different types of timber and terrain in different parts of private land within a tree farm licence area.
 - (c) [Repealed 1999-10-1.]
- (6) The regional manager or district manager must determine an allowable annual cut for each woodlot licence area, according to the licence.
- (7) The regional manager or the regional manager's designate must determine a rate of timber harvesting for each community forest agreement area, in accordance with
 - (a) the community forest agreement, and
 - (b) any directions of the chief forester.
- (8) In determining an allowable annual cut under subsection (1) the chief forester, despite anything to the contrary in an agreement listed in section 12, must consider
 - (a) the rate of timber production that may be sustained on the area, taking into account
 - (i) the composition of the forest and its expected rate of growth on the area,

- (ii) the expected time that it will take the forest to become re-established on the area following denudation,
 - (iii) silvicultural treatments to be applied to the area,
 - (iv) the standard of timber utilization and the allowance for decay, waste and breakage expected to be applied with respect to timber harvesting on the area,
 - (v) the constraints on the amount of timber produced from the area that reasonably can be expected by use of the area for purposes other than timber production, and
 - (vi) any other information that, in the chief forester's opinion, relates to the capability of the area to produce timber,
- (b) the short and long term implications to British Columbia of alternative rates of timber harvesting from the area,
 - (c) the nature, production capabilities and timber requirements of established and proposed timber processing facilities,
 - (d) the economic and social objectives of the government, as expressed by the minister, for the area, for the general region and for British Columbia, and
 - (e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area.

Appendix 2: Section 4 of the *Ministry of Forests Act*

Section 4 of the *Ministry of Forests Act* (consolidated 1988) reads as follows:

Purposes and functions of ministry

4. The purposes and functions of the ministry are, under the direction of the minister, to
 - (a) encourage maximum productivity of the forest and range resources in British Columbia;
 - (b) manage, protect and conserve the forest and range resources of the government, having regard to the immediate and long term economic and social benefits they may confer on British Columbia;
 - (c) plan the use of the forest and range resources of the government, so that the production of timber and forage, the harvesting of timber, the grazing of livestock and the realization of fisheries, wildlife, water, outdoor recreation and other natural resource values are coordinated and integrated, in consultation and cooperation with other ministries and agencies of the government and with the private sector;
 - (d) encourage a vigorous, efficient and world competitive timber processing industry in British Columbia; and
 - (e) assert the financial interest of the government in its forest and range resources in a systematic and equitable manner.

Documents attached:

Appendix 3: Minister of Forests' letter of July 28, 1994

Appendix 4: Minister of Forests' memo of February 26, 1996

Appendix 5: Summary of Public Input





File: 10100-01

JUL 28 1994

John Cuthbert
Chief Forester
Ministry of Forests
595 Pandora Avenue
Victoria, British Columbia
V8W 3E7

Dear John Cuthbert:

Re: Economic and Social Objectives of the Crown

The *Forest Act* gives you the clear responsibility for determining Allowable Annual Cuts, decisions with far-reaching implications for the province's economy. The *Forest Act* provides that you consider the social and economic objectives of the Crown, as expressed by me, in making these determinations. The purpose of this letter is to provide this information to you.

The social and economic objectives expressed below should be considered in conjunction with environmental considerations as reflected in the Forest Practices Code, which requires recognition and better protection of non-timber values such as biodiversity, wildlife and water quality.

The government's general social and economic objectives for the forest sector are made clear in the goals of the Forest Renewal Program. In relation to the Allowable Annual Cut determinations you must make, I would emphasize the particular importance the government attaches to the continued availability of good forest jobs and to the long-term stability of communities that rely on forests.

Through the Forest Renewal Plan, the government is taking the steps necessary to facilitate the transition to more value-based management in the forest and the forest sector. We feel that adjustment costs should be minimized wherever possible, and to this end, any decreases in allowable cut at this time should be no larger than are necessary to avoid compromising long-run sustainability.

.../2

Province of
British Columbia

Minister of
Forests

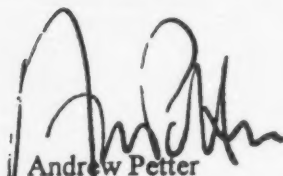
Parliament Buildings
Victoria, British Columbia
V8V 1X4

John Cuthbert
Page 2

In addition to the provincial perspective, you should also consider important local social and economic objectives that may be derived from the public input on the Timber Supply Review discussion papers where these are consistent with the government's broader objectives.

Finally, I would note that improving economic conditions may make it possible to harvest timber which has typically not been used in the past. For example, use of wood from commercial thinnings and previously uneconomic areas may assist in maintaining harvests without violating forest practices constraints. I urge you to consider all available vehicles, such as partitioned cuts, which could provide the forest industry with the opportunity and incentive to demonstrate their ability to utilize such timber resources.

Yours truly,



Andrew Petter
Minister



Province of
British Columbia

OFFICE OF THE
MINISTER

Ministry of
Forests



MEMORANDUM

File: 16290-01

February 26, 1996

To: Larry Pedersen
Chief Forester

From: The Honourable Andrew Petter
Minister of Forests

Re: The Crown's Economic And Social Objectives Regarding Visual Resources

Further to my letter of July 29, 1994, to your predecessor, wherein I expressed the economic and social objectives of the Crown in accordance with Section 7 of the *Forest Act*, I would like to elaborate upon these objectives as they relate to visual resources.

British Columbia's scenic landscapes are a part of its heritage and a resource base underlying much of its tourism industry. They also provide timber supplies that are of significant economic and social importance to forest industry dependent communities.

Accordingly, one of the Crown's objectives is to ensure an appropriate balance within timber supply areas and tree farm licence areas between protecting visual resources and minimizing the impact of such protection measures on timber supplies.

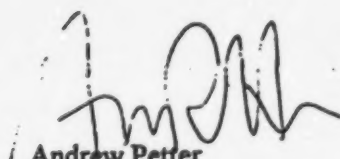
As you know, I have directed that the policy on management of scenic landscapes should be modified in light of the beneficial effects of the Forest Practices Code. In general, the new policy should ensure that establishment and administration of visual quality objectives is less restrictive on timber harvesting. This change is possible because alternative harvesting approaches as well as overall improvement in forest practices will result in reduced detrimental impacts on visually sensitive areas. Also, I anticipate that the Forest Practices Code will lead to a greater public awareness that forest harvesting is being conducted in a responsible, environmentally sound manner, and therefore to a decreased public reaction to its visible effects on the landscape. In relation to the Allowable Annual Cuts determinations that you make, please consider the effects that the new policy will have in each Timber Supply Area and Tree Farm Licence.

.../2

Larry Pedersen
Page 2

In keeping with my earlier letter, I would re-emphasize the Crown's objectives to ensure community stability and minimize adjustment costs as the forest sector moves to more value-based management. I believe that the appropriate balance between timber and visual resources will be achieved if decisions are made consistent with the ministry's February 1996 report *The Forest Practices Code: Timber Supply Analysis*.

Finally, in my previous letter I had asked that local economic and social objectives be considered. Please ensure that local views on the balance between timber and visual resources are taken into account within the context of government's broader objectives.



Andrew Petter
Minister of Forests

Arrow Timber Supply Area Timber Supply Review

Summary of Public Input

BC Ministry of Forests
Arrow Forest District
845 Columbia Ave.
Castlegar, BC
V1N 1H3

January 24, 2001

This is a summary of the public input received on the Timber Supply Review in the Arrow Timber Supply Area. This summary does not assess the feasibility or validity of the input or whether it relates to the clearly defined mandate of the chief forester in the allowable annual cut determination.



Arrow Timber Supply Area

Background

As part of the review of timber supply in the Arrow Timber Supply Area (TSA), two opportunities were provided for public input. The first followed release of the Arrow TSA *Data Package* and *Information Report* in January, 1999. The *Information Report* was a non-technical summary of the draft data and management assumptions that were to be applied in reviewing the timber supply for the Arrow TSA. A 30-day review period, ending February 22, 1999, was provided for the public to comment on these documents.

On April 13, 2000, the British Columbia Forest Service released the *Arrow Timber Supply Area Analysis Report* and *Public Discussion Paper*. The public was encouraged to review and comment on the accuracy of the information in these documents and to provide additional information during the 60-day review period that ended June 12, 2000.

This report summarizes the input received during both public review periods. This information was provided to the chief forester for his consideration when he reviewed the allowable annual cut (AAC) for the Arrow TSA. The first section of this summary outlines the public review process implemented by the Forest Service, and describes the types of public input received. The second section summarizes the public input in sufficient detail to indicate the range of input received. The original submissions (with personal identifiers removed in accordance with the *Freedom of Information and Protection of Privacy Act*) can be reviewed at the Arrow Forest District office.

Public Review Process and Response

Arrow District staff actively solicited public input on the Timber Supply Review in the Arrow TSA through the following actions:

- direct mail-out of approximately 80 copies of the *Information Report*, *Data Package*, *Analysis Report* and *Public Discussion Paper* to key organizations in the Arrow TSA or adjacent TSAs.
- the *Data Package* and *Analysis Report* were available at the district office and approximately 15 were picked up.
- meetings regarding both the *Data Package* and *Analysis Report* were held with local MLAs and forest industry representatives.
- information packages were sent to local governments, with an offer of presentations by district staff. None were requested.
- referrals were made to the Ministry of Forests website where documents were available to download.

As Table 1 shows, approximately seven individuals attended meetings or information sessions. The Arrow Forest District also received eight written submissions on the *Data Package* and eight submissions on the *Analysis Report* (see Appendix 1).

Participants (#)	Date
<u>Elected officials</u>	
MLAs (2)	Jan. 20/99 & Apr. 12/00
<u>Interest groups</u>	
Licensees (5)	Nov. 24/99, Jan. 26/00, Mar. 29/00 & June 1/00

Table 1: Participation in public information activities

Public Input

In this section, public input on the information presented in the Timber Supply Review documents for the Arrow TSA is summarized under the following headings:

- Data Package (and Information Report)
- Timber Supply Area Analysis Report (and Public Discussion Paper)
- Other comments

Arrow Timber Supply Area

Data Package

Land Base Factors

Three submissions question how the operable land base is defined for this timber supply analysis. The Arrow licensees' submission questions whether the operability line has been updated since the early 1990s, and offers new information on operability that has resulted from work in the Innovative Forest Practices Agreement (IFPA) area. The Interior Lumber Manufacturers' Association (ILMA) questioned the assumptions around areas described as 'N' under operability.

Two submissions suggest that current low pulp and lumber prices and the poor forecasts for recovery to higher prices indicate the need to lower the operability line, or at least the need for a sensitivity analysis. The Valhalla Wilderness Society (the Valhalla Society) suggests a more stable set of guidelines is needed to determine operability and provides a suggested approach. The Valhalla Society and the Slocan Valley Watershed Alliance (the Watershed Alliance) also question whether blocks that are to be added to the timber harvesting land base (THLB) as a result of the 1997 total chance plan are only from the eight landscape units considered in that plan. The Valhalla Society further questions whether proposed helicopter blocks were included in the THLB and whether they are truly proving to be operable.

The Valhalla Society points to the need to better define the alpine timber type and determine its potential contribution to timber supply. The Society also says a sensitivity analysis is needed to reflect the constrained contribution of domestic and community watersheds to the operable land base, due to public opposition and other constraints. They also expressed the opinion that currently deferred areas should be removed from the THLB.

The Watershed Alliance and the Valhalla Society say that although inventories of sites of cultural or archaeological value are not complete, at least the known sites should be protected with a buffer and modeled in the analysis.

Environmentally Sensitive Areas

The Arrow licensees' submission says it is their understanding terrain hazard surveys will supplement environmentally sensitive area (ESA) designations, not replace them, and suggests restrictions on the use of the data. The licensees say they recognize some additional area deductions may be needed to address sensitive terrain issues, but maintain the current approach is more conservative than the approach taken in other TSAs and TFLs in this Timber Supply Review. Specific concerns are detailed.

The Watershed Alliance expresses the opinion that the use of actual terrain hazard mapping is an improvement over the old ESA mapping, and that reductions from the land base for terrain hazard should be increased 10 to 20% to reflect current practice. The Valhalla Society says Class V sites should be 100% excluded from harvesting, Class IV should have a 40% reduction, and some Class III should be removed in a sensitivity analysis.

The Watershed Alliance and the Valhalla Society maintain that domestic watersheds are being managed as community watersheds in many instances in the Arrow TSA, and therefore the same ESA reductions should be applied to both types of watersheds to reflect current management.

Both organizations point to avalanches associated with harvesting, both pre- and post-Forest Practices Code requirements. The Watershed Alliance says ESA mapping needs to be updated and the ESA reductions for avalanches increased. The Valhalla Society says a finer screen is needed to determine avalanche sensitivity, and an inventory of land lost to avalanches throughout the TSA is required.

Arrow Timber Supply Area

Low Productivity and Problem Types

The Arrow licensees note that the criteria for low productivity sites will result in 2,000 to 3,000 hectares of harvested area being removed from the THLB. They suggest maintaining the criteria but considering if previously logged areas can be included in the THLB.

The licensees question deductions relating to cedar-hemlock and mixed hemlock problem forest types. An individual submission says the timber in stands classed as problem forests should be utilized if possible instead of being left to rot or blow down.

Roads, Trails and Landings

The Arrow licensees say the deductions for existing landings and roads seem reasonable, but question if skid trails are portrayed accurately in the inventory data, and noting that the width of four metres may be excessive if, for example, trees are planted on each edge of the trail. The licensees say the deductions for future roads and landings are also reasonable, but the deduction for future trails seems very high. They provide comparisons with other TSAs and TFLs, and recommend a 1% deduction for future trails.

The Valhalla Society and the Watershed Alliance question if reductions for soil degradation include compaction from feller-bunchers and site preparation equipment, as well as landslides and debris torrents. The Watershed Alliance says the value for existing trails seems low given the lack of accurate representation of old trails in the inventory data base and the degree of productivity loss on those trails.

The Valhalla Society and the Watershed Alliance express the opinion that roads, trails and landings should not be removed from the land base, but modeled as early seral. These areas would then contribute to biodiversity requirements and the calculations of equivalent clearcut areas (ECAs) in watersheds, according to the Society.

An individual submission says a realistic number of key forest access roads should be left intact for public use, rather than being deactivated. It is this individual's opinion that if more logging on public land is desired, this would be an appropriate trade-off for the public good.

Volume Estimates

The Valhalla Society asks if any volume-ratio studies have been done and, if so, if they were incorporated into the analysis. The Society says that since forest companies regularly log the highest volume stands first, it follows that the remaining stands should have less volume.

The Watershed Alliance and the Valhalla Society express the opinion that modelling all harvesting as clearcut may inflate volume estimates, given that one-third of harvesting will be partial cuts. They say a better approach to modelling partial cutting is needed. The ILMA and the Watershed Alliance question how *Armillaria* root disease is handled in the analysis, noting the chief forester's direction in the 1995 Rationale Statement to quantify the impacts of root disease. The ILMA also questioned any additional adjustments for root rots beyond what is already accounted for in the models used to project existing and managed stand yields.

The Watershed Alliance says operational adjustment factors (OAF2s) should be modeled in the analysis, not just treated as a sensitivity analysis. The Valhalla Society agrees, saying studies show losses to root rot and spruce terminal weevil are in the range of 25% in the Arrow TSA; therefore OAFs need to be adjusted and this change modeled in the analysis.

Arrow Timber Supply Area

Expected Rate of Growth

The Arrow licensees and the Interior Lumber Manufacturers' Association (ILMA) express the opinion that the results of the Old Growth Site Index study should be modelled in the base case, not just as a sensitivity analysis. The Watershed Alliance says the study results are not even appropriate for a sensitivity analysis given the lack of reliable data.

Minimum Harvestable Age

The Watershed Alliance and the Valhalla Society express the opinion that harvesting should not occur until stands reach the culmination age (when annual growth is maximized) in order to maximize the yield and economic benefit. Both organizations request a sensitivity analysis to test this approach.

The Arrow licensees note that the criteria used to define minimum harvestable age should produce ages similar to the last Timber Supply Review, which should be compatible with current practice. The licensees agree with the sensitivity analysis proposed (+/- 10 years) and note that in future, economics and technology may allow smaller piece sizes and lower volumes to be harvested. The ILMA notes the importance of this factor and request further detail and rationale.

Regeneration

The Arrow licensees say they agree that a two-year regeneration delay represents current practice but note that for modeling purposes, the age of the planted stock should be deducted.

The Watershed Alliance and the Valhalla Society say the present rate of restocking backlog not satisfactorily restocked (NSR) areas does not support the assumption that 70% of the backlog will be restocked within 10 years, particularly with reductions in Forest Renewal BC funding. The Watershed Alliance says backlog NSR areas should be removed from the THLB until they're restocked.

An individual submission says in an area of 754,000 hectares where a high rate of harvesting has been ongoing for many years, only 2,012 hectares of NSR seems deceptively low.

Visual Quality

The Arrow licensees request confirmation of the inclusion of visual corridors from the Kootenay Boundary Land Use Plan (KBLUP). The licensees note that cover requirements do not allow for a partial cutting allowance although numerous partial cuts have been done in visually important areas in recent years. The licensees recommend adjusting cover requirements upward and slope criteria downward.

The Valhalla Society and the Watershed Alliance express the opinion that the 2% rollback of timber supply impacts for visual quality will be opposed in the Slocan Valley for economic and social reasons. The alliance says more restrictive requirements consistent with those approved in previous public processes should be modelled.

Biodiversity

The Watershed Alliance requests a sensitivity analysis on immediate full implementation of older forest targets in low biodiversity emphasis areas. The alliance says the three-rotation delay in implementing these targets is unreasonably long and represents a threat to biodiversity. The Valhalla Society requests a sensitivity analysis of proportional representation of biodiversity seral stage requirements applied to each landscape unit.

With regard to landscape level biodiversity, the ILMA expresses the hope that the developing provincial process of landscape unit planning will be monitored and the Arrow process adjusted to be consistent, if needed.

Both the Valhalla Society and the Watershed Alliance say the assumption that non-contributing forests will age over time ignores events such as fire, insect infestation,

Arrow Timber Supply Area

windthrow and landslides. They say the analysis should reflect natural patterns in the non-contributing forest. The two groups also maintain that in modelling old forest retention requirements the values for actual old forests present should be used, rather than using the numbers from the Biodiversity Guidebook which assume 12% of old forest is already in Protected Areas in each biogeoclimatic unit.

The Valhalla Society and the Watershed Alliance submissions also say wildlife tree patches should not be counted as contributing to old forest requirements, as they are too small to contain interior forest conditions or other attributes necessary for an old forest.

Wildlife and Fish

Two submissions note the need to complete an inventory of goshawk and heron nests. The Watershed Alliance says the number of nests modelled should be increased by 50% to account for those not yet found.

The Valhalla Society notes that the ungulate winter range (UWR) inventory should be adjusted to include moose winter habitat. The Ministry of Environment (MoE) submission says the UWR mapping does include areas used by moose, although moose are not mentioned in the *Data Package*.

The ILMA says that since the KBLUP Implementation Strategy (KBLUP-IS) does not have legal standing, they would like to see assumptions regarding UWR compared to the forthcoming instructions for completing forest development plans, as well as a series of sensitivity analyses around feasible caribou management rules. The MoE submission maintains the Arrow Forest District does have legally defined UWR and an approved management strategy.

With regard to wildlife tree patches (WTPs), the Arrow licensees provide several reasons why an area reduction of 2% would be more reasonable. The ILMA asks to see evidence of WTP results and requests a comparison of the sample of silviculture

prescriptions mentioned in the *Data Package* with a GIS process using the May 25, 1998, letter from the chief forester regarding the application of WTPs.

The Arrow licensees maintain that a list of regionally significant fish-bearing streams has not been completed nor have required management practices been defined. Therefore, forest cover requirements in the *Data Package* are not current management and should only be considered in a sensitivity analysis, according to the licensees. The MoE submission notes the necessity of recognizing measures to protect fish streams as current management.

Forest Cover Requirements

The Arrow licensees say the Integrated Resource Management requirements for maintaining 70% of the area in stands older than 40 years should be removed. They cite several reasons that this constraint is too conservative, concluding it could result in a significant reduction in harvest rate in the portion of the land base that is supposed to have the fewest non-timber values.

Riparian Management

The Arrow licensees say the riparian deduction is very significant and appears higher than what is experienced in practice. The licensees say most larger streams flow through private land, so the riparian deduction should be quite low. The ILMA requests information on the methodology used to determine the volumes affected by riparian reserves and management zones.

The Watershed Alliance says current practice is to provide buffers for small streams in domestic watersheds, similar to community watersheds. The Watershed Alliance and the Valhalla Society point to KBLUP-IS requirements for management of areas upstream of domestic water intakes. The Watershed Alliance says this should result in reductions from the THLB, while the Valhalla Society recommends a sensitivity analysis on the impacts of this policy.

Arrow Timber Supply Area

Watershed Cover Requirements

Three submissions comment on the maximum allowable disturbance (or ECA, equivalent clearcut area) in watersheds. The Arrow licensees express agreement with basing these requirements on the condition of the entire Crown forest area, rather than just the THLB, but note that the allowable disturbances are much lower than those in the KBLUP. The licensees say other timber supply analyses have used less restrictive requirements (e.g., Cranbrook and Revelstoke TSAs) and provide some recommendations on revisions.

The Valhalla Society says the determination of ECA in any watershed must include the condition of private land. The Watershed Alliance says research by hydrologists challenges the validity of using ECAs in watersheds, maintaining that each watershed requires detailed risk analysis.

Both the Valhalla Society and the Watershed Alliance also point to additional work which indicates that nine metres is likely insufficient for hydrologic green-up; a sensitivity analysis using increased standards such as a 12 metre green-up is requested. The Arrow licensees express the opinion that a green-up of six to seven metres is more representative of operational reality, allowing resumption of harvesting after partial hydrological recovery.

The ILMA questions the process and assumptions used to address hydrological concerns.

Harvest Scheduling

The Arrow licensees agree with using relative oldest first as the harvest scheduling rule for the analysis. The Watershed Alliance and the Valhalla Society say the model should reflect the age class mix being harvested, which would be a random mix of ages. The Alliance is of the opinion timber volumes will be inflated by modeling relative oldest first.

Non-Recoverable Losses

The Valhalla Society says the calculation of losses attributable to fire amounts to about 20 hectares per year. Given the catastrophic fires in the adjacent Kamloops Forest Region last year and the predicted effects of global climate change, the Society says this figure should be doubled. An individual submission states that using only unsalvaged loss figures understates the losses due to fire in the TSA.

The ILMA questions how loss factors were developed and how they will be modelled. The Watershed Alliance notes unsalvaged loss estimates should include the impacts of global warming and climate change.

Socio-Economic Objectives

The Watershed Alliance asks that the chief forester consider as a statement of local objectives the recently completed *Building a Healthy Valley Economy -- A Community Action Plan*, prepared for the Slocan Valley Community Economic Action Plan steering committee.

An individual submission says the first and most important objective is to provide enough wood to allow mills to operate at current levels because the economic viability of mills is critical to surrounding communities.

Another individual says the fact that the forest sector accounts for only 15% of the area's total employment and that the Castlegar pulpmill is operating under receivership proves something is very wrong. Due to highly mechanized logging methods, B.C. forests are being liquidated with very little employment gain and a very small margin of profit, according to this individual, and therefore export of logs and cants from the Arrow TSA or from the province should not be allowed.

Arrow Timber Supply Area

Timber Supply Area Analysis Report

Following release of the *Analysis Report*, the Arrow Forest Association (AFA), representing most forest licensees in the Arrow TSA, commissioned an alternative timber supply analysis. This analysis was based on an earlier one done under the IFPA, but was updated to use the same inputs as the Ministry of Forests' analysis. The AFA analysis then evaluates the timber supply impact of altering five inputs to the analysis:

- the operable land base was updated based on harvest history since 1991 (when operability lines were last revised), approved forest development plans and local knowledge. The use of the updated operability line reduced the size of the inoperable land base by 6.3%. The AFA requests that the revised operability information be considered as it reflects current practice.
- the land base reduction of 2% to account for future skid trails was eliminated. The AFA believes these trails will be rehabilitated in compliance with the Forest Practices Code and should not be removed from the harvesting land base.
- the approach to land base reductions to account for sensitive soils and terrain was modified from that used by the Ministry of Forests, which the AFA believes is an overly conservative approach.
- the results of the recently completed project *An Analysis of the Impact of Current and Planned Seed Orchard Program on Timber Flow in the Arrow TSA* were incorporated, resulting in future timber volume gains attributed to the use of genetically improved seed.
- a visually effective green-up height of five metres was applied (compared to the Ministry's analysis which uses six or seven metres), which the AFA believes is a more reasonable approximation for the Arrow TSA.

The alternative analysis then considers three forecasts, using different combinations of the above factors. Other than the benchmark forecast, which is the same as the *Analysis Report's* base case forecast, the two other forecasts indicate the ability to maintain the current harvest level for three decades and to increase the mid- and long-term harvest levels by 9% and 7% respectively. According to the AFA, the alternative forecasts provide additional, technically defensible information to be considered during the AAC determination.

Other Comments

Several submissions comment on factors or issues other than those specifically covered by Timber Supply Review documents. These comments are summarized in this section.

First Nations

The submission from the Westbank First Nation says the Arrow TSA lands and resources fall within their traditional territory and form part of a land claim filed in 1993. All land use matters must be resolved through a process of negotiation and must be presented formally at a treaty-making table or other acceptable venue, according to this submission. The Westbank First Nation says it views the continued alienation of its aboriginal title and the infringement on its rights by the B.C. and Canadian governments as bad faith negotiations.

An individual submission expresses strong opposition to the alienation of resources inherent in First Nations claims against the land and resources of the Arrow TSA and other parts of the province.

Timber Supply Review Process

The ILMA says the absence of specific data in the *Data Package* makes it hard to evaluate, and notes various concerns regarding analysis units. Assumptions based on the KBLUP-IS should not be used in this analysis, as the plan does not have standing in law and these

Arrow Timber Supply Area

assumptions could be legally challenged, according to the ILMA. The Valhalla Society says the plan and implementation strategy have been approved as a policy statement of government and questions whether they have formed part of current management practices in the analysis.

An individual submission says the *Data Package* and *Information Report* are technical and unappealing to the layperson. If meaningful input is desired, more attractive publications and an open house are needed, according to this submission.

Management Practices

An individual submission says B.C.'s highly mechanized approach to the liquidation of our forests must end and the focus shift to diversification, specialization, secondary manufacturing and value-added products to maximize returns from the forest resource. This individual questions practices such as whole tree skidding, pushover logging and run-away slash burns, and notes that logs should be milled as close as possible to their place of origin to minimize hauling over mountain passes.

Innovative Forest Practices Agreement

A submission from the Arrow IFPA licensees is provided as background information to show the strategic level projects being undertaken under the IFPA (improving the information base; evaluating short-term timber availability constraints and options; more accurate definition of the THLB; and maximizing the productivity of the land base, especially of regenerated stands). The report says the primary objective of the IFPA is to maintain the AAC and associated employment levels in the short and long term while maintaining or enhancing environmental values.

Harvest Levels

Given concerns and research on terrain stability in the Slocan Valley, the Valhalla Society questions if the present rate of cut in the Slocan Valley can be maintained.

The Watershed Alliance states its support for a reduction in the apportionment of the AAC to the Slocan Valley due to a number of factors including past harvesting history, the continuing contentious nature of logging in the valley's visual corridor and domestic watersheds, terrain instability problems, and the non-fulfillment of the chief forester's 1995 direction to identify appropriate harvest targets for areas in which harvesting has been avoided. The Watershed Alliance requests that the FRBC funded report 'Building A Healthy Valley Economy: A Community Action Plan' be considered as public input.

An individual submission says the AAC must allow mills to continue to operate at current levels, as their well-being is imperative to surrounding communities. The submission from the IFPA licensees notes that the IFPA's base case analysis shows the amount of available timber is almost equal to the current AAC.

Submissions from Slocan Forest Products Limited, Bell Pole Company, Kalesnikoff Lumber Co. Limited and Atco Lumber Limited indicated that they supported the forecast 'C' presented in the AFA technical submission.

Appendix 1

Submissions received by the Arrow Forest District

Submissions received on the Data Package

First Nations

Westbank First Nation, Chief Ron Derrickson

Government agencies

Ministry of Environment, Forest Ecosystem Specialist, Castlegar

Forest Industry

Arrow TSA Licensees

Interior Lumber Manufacturers' Association

Interest groups

Slocan Valley Watershed Alliance

Valhalla Wilderness Society

General Public

Two individual submissions

Submissions received on the Timber Supply Analysis Report

Forest Industry

Arrow IFPA/Arrow Forest Licence Group

Arrow Forest Association

Atco Lumber Limited

Bell Pole Company

Kalesnikoff Lumber Co. Limited

Riverside Forest Products Limited

Slocan Forest Products Limited

